Semi-Annual Meeting, St. Louis, Missouri, November 29-30, 1953

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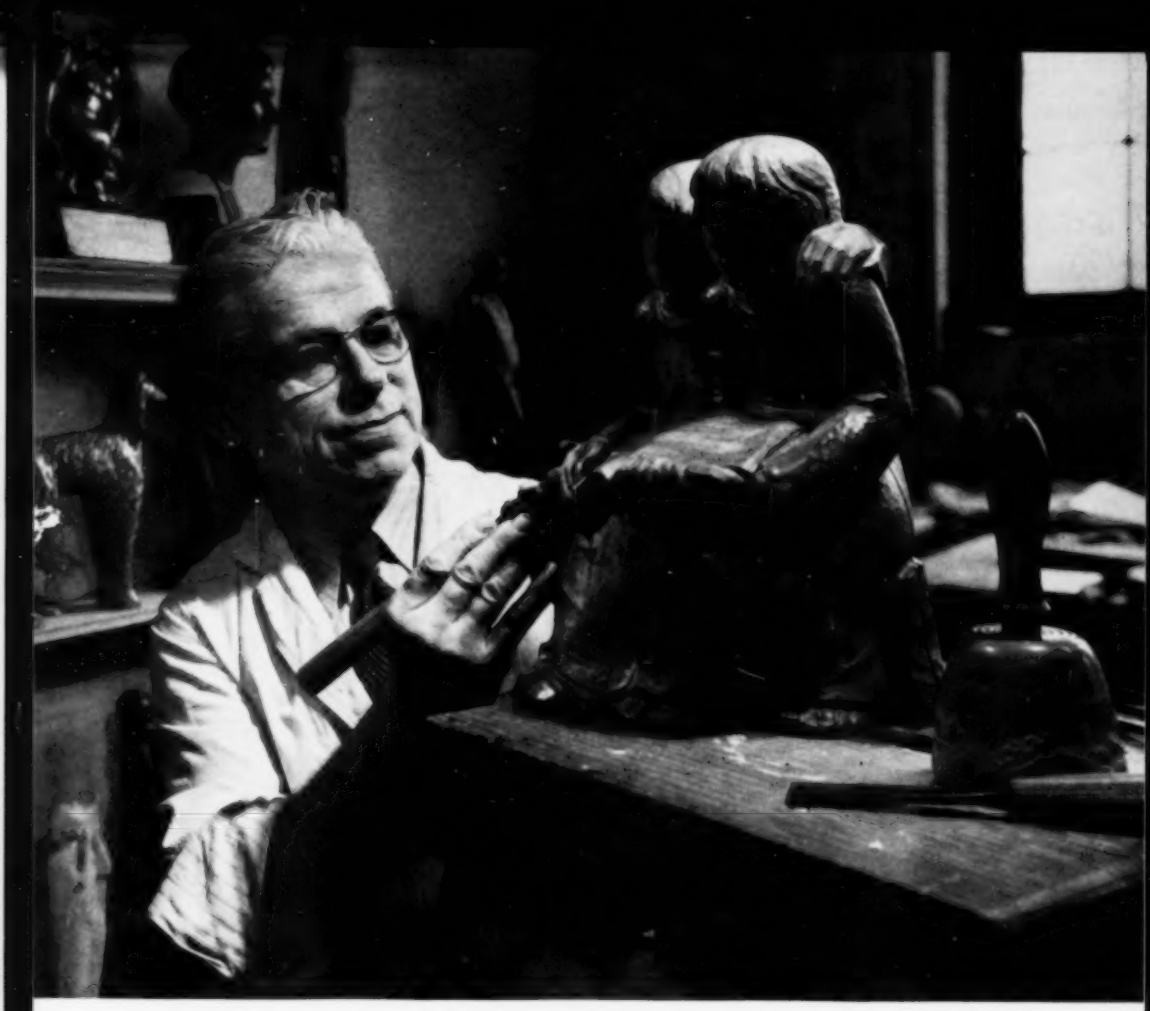

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EXECUTIVE OFFICE
112 East Chestnut Street, Chicago 11, Illinois
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COLLEGE EVENTS

NATIONAL AND INTERNATIONAL MEETINGS

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St. Louis, Missouri, November 29-30, 1953.

20th Annual Meeting, American College of Chest Physicians,
San Francisco, California, June 17-20, 1954.

Third International Congress on Diseases of the Chest
American College of Chest Physicians
Barcelona, Spain, Fall, 1954

Tenth Congress of the Union of Latin American Societies Against Tuberculosis,
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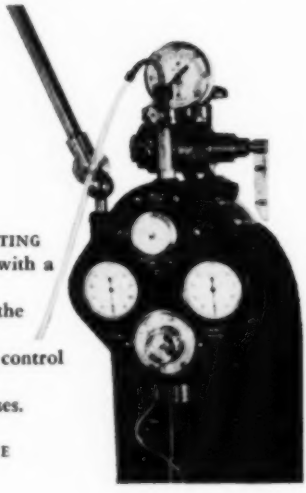

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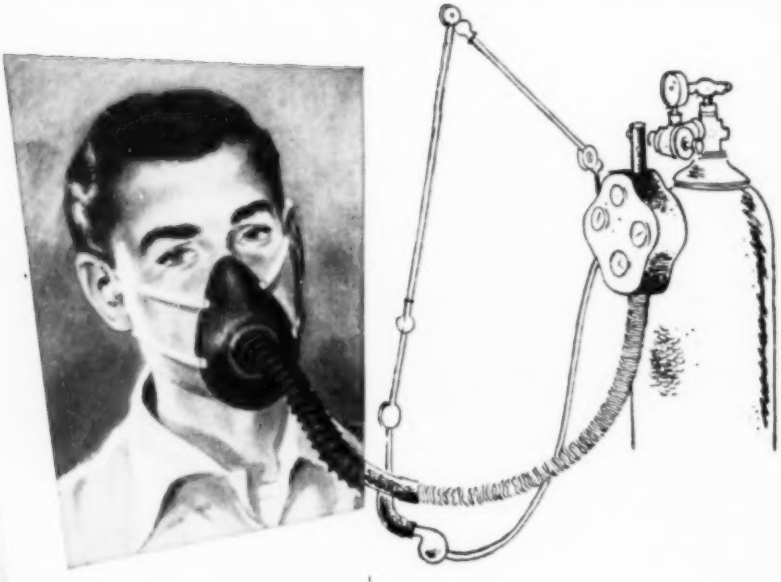

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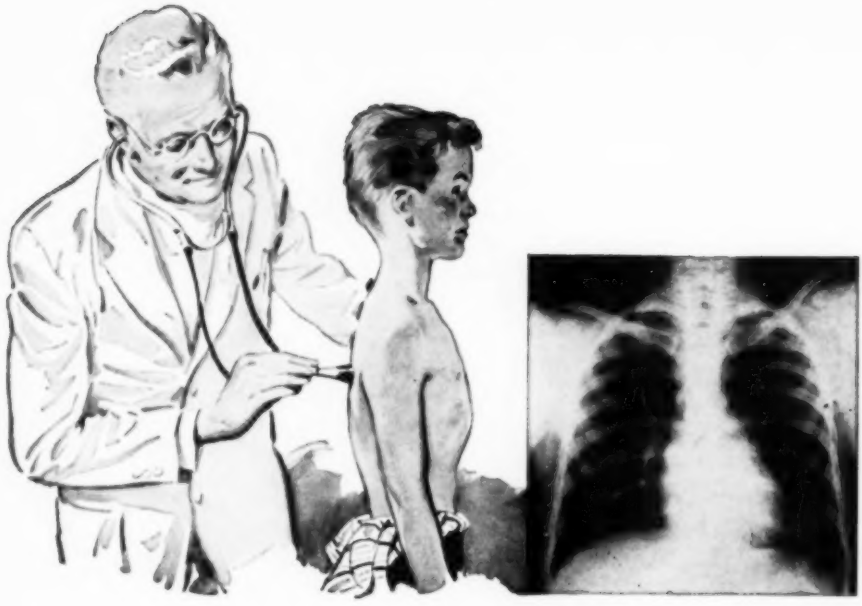

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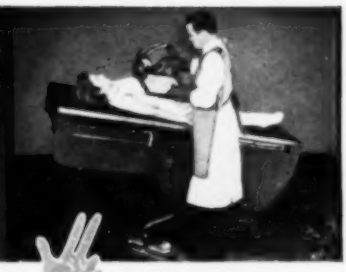

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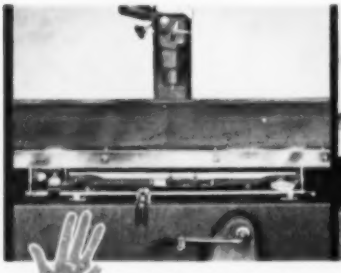

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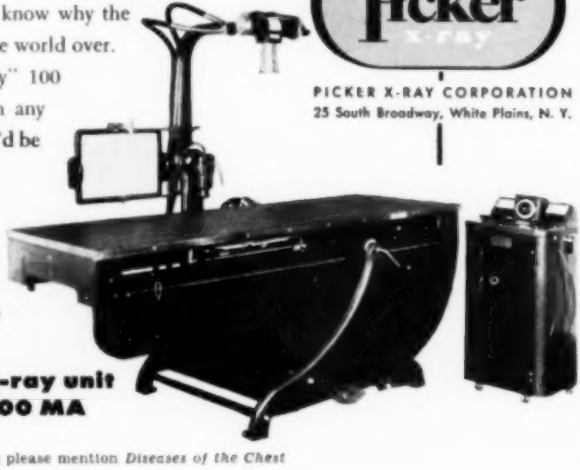

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DISEASES *of the* CHEST

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Development of a Psychological Program in a Tuberculosis Hospital*

BARBARA M. STEWART, Ph.D., RICHARD R. CASADY, M.D. and DAVID SALKIN, M.D., F.C.C.P.
San Fernando, California

Introduction

The following report describes experiences encountered during the first six months of a psychological program in a Veterans Administration tuberculosis hospital. This hospital was among the first of its kind to initiate such a program, and did so because of a recognition of the importance of emotional factors in the treatment of tuberculosis, and of the need for specialized psychological services to supplement those offered as a part of the general treatment plan.

Psychological factors are considered to be particularly important in the treatment of tuberculosis because, with this illness, a patient is confined for long periods of time to enforced inactivity, made less bearable by the absence of discomfort or pain associated with many other chronic diseases. Separated from family and friends, often burdened by economic worries, and with the knowledge that his activities must be permanently curtailed, the tuberculous patient suffers emotional distress which can have debilitating effects on his ability to take the prescribed treatment.

While most phthisiotherapists acknowledge the role of emotional factors in this disease, they are usually unprepared to carry alone the full responsibility for psychological treatment of their patients. Even in those cases where, by training or experience, the physician has developed methods for dealing with the emotional aspects of illness, he needs the assistance of one who has at his disposal techniques and skills which can be acquired only through specialized training in the field. Not only should consultation be available to assist him in his own psychological treatment of patients, but there should be on the staff a trained person to whom the physician can refer problems requiring attention beyond that which he is prepared to give. In addition to being handicapped by lack of intensive psychological training, he is also limited by the many demands on his time which make it impossible for him to give extra attention in those cases where it is

*From the Veterans Administration Hospital, San Fernando, California, and the Department of Medicine, University of California School of Medicine, Los Angeles, California.

particularly needed. Referral to a member of the psychological staff offers a solution to this problem.

Initiating a Program

This program was developed by a staff of a full-time psychologist and a part-time psychiatrist who served as consultant one day per week. Since there was no resident psychiatrist at the hospital, and because the chief responsibility for developing the service rested with the psychologist, the program is referred to as a psychological one.

The staff was guided by Veterans Administration regulations in defining the duties of the clinical psychologist as follows:

1) *Diagnosis:* Applies psychological principles and techniques to the diagnosis of emotional problems, including those of adjustment to hospitalization and the psychosomatic aspects of tuberculosis and associated diseases; administers and interprets tests of intelligence and personality.

2) *Therapy:* Carries out psychotherapeutic treatment of patients with emotional problems, as directed by psychiatrists.

3) *Consultation:* Confers with psychiatrists, physicians, social workers, and other professional staff members, regarding individual cases under treatment and regarding general professional and station procedures.

4) *Teaching:* Supervises and instructs trainees in the field of clinical psychology, and collaborates in the training of hospital personnel and trainees in other related fields.

5) *Research:* Conducts research in personality development and adjustment of tuberculous patients.

Since there was no established procedure for introducing such a program in a tuberculosis hospital, various means were considered by which this might be accomplished. Realizing that a psychological service is often met with resistance by various members of a hospital staff, it was decided that casual, informal discussions were preferable to a more organized attempt to sell the program. Accordingly, opportunities were first arranged to meet individually with physicians in order to acquaint them with the nature of the service offered, and to learn from them how it might best meet their particular needs. Members of other professional groups whose functions are related to those of this service were also sought out, particularly Social Service, Rehabilitation, and Vocational Advisement personnel.

As referrals were received from ward physicians, the psychology staff became acquainted with patients and learned directly from them those areas in which they felt a need for psychological help. A further opportunity to meet with patients was provided by a request that the psychologist and psychiatrist assume leadership of a previously existing therapy group which had formerly been conducted by the allergy consultant.

Requests for lectures to various hospital groups were received and were welcomed as a means of making known the nature of the service. Such talks were given to nurses, volunteer workers, rehabilitation personnel, and other groups.

Although it was recognized that the research function should be an

important consideration, such activity was postponed until the important problems in this type of hospital could be defined and the feasibility of various experimental designs could be determined.

Experience with diagnosis and individual psychotherapy: Requests for diagnostic evaluations or treatment were received from ward physicians, infrequently at first, but in greater numbers later as patients themselves learned of the service and began to initiate their own requests for consultation. These referrals were directed to the psychologist who in turn selected those to be referred to the psychiatrist at the time of his next visit. In the case of patients who developed psychiatric symptoms requiring immediate attention, a psychiatrist was called in from a nearby neuropsychiatric hospital and, when recommended by him, transfer of the patient to that hospital was arranged. In general, patients for whom a formal psychiatric diagnosis was requested and some for whom short-term psychotherapy was indicated were examined and treated by the psychiatrist; patients requiring more extended therapy were treated by the psychologist whose full-time status enabled her to devote the necessary time to such treatment. Consultations with the psychiatrist on cases handled by the psychologist were held at intervals throughout the course of therapy.

In those cases referred for diagnosis only, relatively little psychological testing was done. The infrequent requests often arose on an emergency basis, and a diagnostic interview made possible a report to the ward physician within a much shorter time than would have been possible if a battery of tests had first been administered. In most cases referred for psychotherapy, motivation and suitability of the patient for treatment was determined without tests on the basis of one or two exploratory interviews.

Referrals for individual psychotherapy outnumbered requests for diagnosis. The cases for whom therapy was indicated ranged from those presenting minor situational maladjustments to those having deep-seated problems of long duration. Interviews were held once or twice a week, and in no case where the patient required continued treatment over a period of many months was this service denied him; however, the steady increase in the number of requests presented a problem of finding time to fulfill such demands. Although treating patients in groups might have provided a solution, attempts to meet these needs collectively did not prove to be satisfactory.

Experience with group psychotherapy: In reorganizing the therapy group of ambulatory patients, originally selected on the common basis of allergic reactions, it was decided to divide the patients into two sections, one of which consisted of five younger men soon to be discharged, and the other of 10 older men whose tuberculosis had become chronic. Although the previous sessions had been conducted with a didactic emphasis, it was planned that future meetings would be directed toward interpretation of interpersonal relationships, with a minimum of participation by the group leaders. In order to include women patients in the group-therapy program, a third group of nine women was organized on the women's ward. Each of the three groups met once a week. The two groups of men and the group

of women met eight, six and nine times, respectively. However, interest in the meetings was not maintained, and attendance eventually dropped to approximately three members in each group. Several of the remaining patients were then discharged from the hospital, at which time the meetings were discontinued.

In describing their reaction to the group sessions, the opinion most frequently expressed by the members was that the therapists should be more active in their leadership. They explained that patients in this hospital are together on the ward at all times and know each other well. They complained of too much regimentation, and expressed no particular desire to increase their feeling of group belongingness. What they do need, according to them, is closer contact with their ward physician who, because of the pressure of his duties, cannot give to each one the personal attention he desires. They hoped that meetings with the psychiatrist and psychologist would partially offset the frustration engendered by their inability to appropriate time of the ward physician for more frequent discussions of their own individual problems. The refusal of the therapists to adopt an active and relatively authoritarian role was interpreted as a rejection and an unwillingness to fulfill the promise that the groups were organized to meet the patients' needs.

In group psychotherapy with tuberculosis patients, in contrast to that with neurotics, it may be that gratification of the needs arising from their very real dependency on the hospital staff should be a part of the therapeutic plan. Frustration of these needs, and the anxiety aroused in patients through too much emphasis on emotional independence, may have a detrimental effect on their recovery from tuberculosis. Since the first concern must be the physical welfare of the patient, it may be that the group leaders should abandon their passive role and become more giving, supporting, and reassuring, at the same time assuming greater responsibility for the group discussion.

A special problem for group therapy in a tuberculosis hospital arises from the fact that the physical condition of the patient often prevents his participation in an activity for which he is required to be out of bed. The physical limitations in most cases must take precedence over attendance at group meetings, but the improvement in emotional adjustment for some patients to be gained from group membership might offset the harm done by disruption of a bedrest regime. This question of participation could be decided on an individual basis by the ward physician in consultation with the psychological staff.

Attitude of patients toward the service: No general announcement of the availability of psychological services was made to the patients, and during the early months all initial contacts were arranged on an individual basis through referral by the ward physician. An immediate problem to be considered was the opinion held by many patients that a visit from a psychiatrist or psychologist is the first step toward being considered abnormal, resulting in possible transfer to a neuropsychiatric hospital. Few of them understood that such consultations are primarily for the purpose of assist-

ing them to a better adjustment within their own hospital setting. Of those who did understand, some were undoubtedly deterred from accepting treatment for fear of ridicule from others who often referred to the staff as "nut doctors" or "thought police," and to patients seeking help as "psycho."

Further attitudes of resistance developed when, on several occasions, referrals were made as a disciplinary measure imposed on recalcitrants. It was the opinion of the psychological staff that success of the program would be seriously endangered by such use of the service, and it was strongly suggested that it should not be used for punitive purposes.

In order to counteract these negative reactions, at the time a referral was made the ward physician was questioned regarding the patient's knowledge of it and his attitude toward it. If the patient showed resistance, it was suggested that he not be forced to comply. In the case of those who yielded reluctantly to the urging of their physician, these feelings were dealt with immediately and, if they persisted, the interview was terminated with full acceptance of the patient's right to withdraw if he wished.

A more acceptable concept of the service's function gradually developed as a result of the efficient hospital grapevine, through which favorable accounts of personal experience with the psychological staff were circulated among the patients. As a rule, patients who dared to consult with the staff were those who had a feeling of security sufficient to overcome the disparaging attitude of others. By the same token, they were often group leaders and, in endorsing the service, they set the pattern for others to adopt a similar attitude. Gradually the number of referrals initiated by patients themselves began to match those made by the doctors.

In general, those patients who had been adequately prepared by their physician, and referred by him with the patient's consent, showed little resistance to the service and responded favorably to their contacts with it. It has been no more difficult to deal with patient resistance in this hospital than in any setting where such services are equally unknown. With the exception of the group therapy participants, patients have been responsive to the usual techniques for dealing with resistance.

Attitude of medical staff toward the service: The most challenging problem in setting up this program has been that of understanding and dealing with the attitude of the medical staff.

When the plan for a psychological service was first presented by the medical director, there was opposition to it among some of the younger doctors. The reason was not clear, but their attitude may have resulted from previous unfavorable experiences with such programs. The older doctors, who generally favored the plan, may have had less direct contact with a specialized psychological service but, possibly through their added years of experience, had come to a greater recognition of need for it.

In spite of these contradictory points of view, the psychological program was initiated and, after a two months' trial period, the matter was again reviewed. At this time, the medical staff was in agreement as to the value of the service and the desirability of its being retained on a permanent basis.

This change in attitude appears to have been based more on a personal

acceptance of the psychological staff than on an increased awareness of benefits to be gained by such a program. This is suggested by the fact that, although the 12 ward physicians were friendly in their chance encounters with the staff, during the period covered by this report only four of them made any consistent use of the service. Of these four, some made referrals without a clear understanding of the types of problems which might be amenable to psychological treatment, and thus selected patients to whom the staff could be of relatively little assistance.

Accordingly, efforts were made to discuss with physicians those cases selected for referral, to explain what could or could not be expected by way of results, and generally to emphasize what psychology could offer to supplement medical treatment of the patient. It was believed that developing close working relationships with those doctors who did make referrals would lead gradually to use of the service by other members of the medical staff, and that respect for the program on a professional basis would follow as a result of successful experience with it.

Attitude of non-medical staff toward the service: Cordial attitudes toward the service were expressed by non-medical personnel, and attention was given to developing good working relationships with them. For example, discussions were held with social service workers regarding a possible overlap in function between their service and the psychological one. The concept of a team approach was favored as offering the best solution to any such problem which might arise. Conferences were also held with members of the physical medicine rehabilitation staff and the nursing staff with a view to achieving a better understanding of patient problems.

Further Development of the Program

A review of the first six months' experience in developing a psychological program resulted in the following evaluation and plan for the future:

1) *Diagnosis:* Diagnostic studies of patients with the aid of psychological tests will receive greater emphasis, and efforts will be made to acquaint the medical staff with the value of this function. This plan will be facilitated by an increase in personnel through the assignment of psychology trainees to the hospital, whose duties will include routine testing and interviewing of all newly admitted patients.

The admissions program will provide a personality evaluation of each patient, and will also serve as a screening measure to locate those already in need of psychological treatment or those for whom preventive measures are indicated. Reports to physicians will include recommendations as to the best individualized approach to the patient in order to elicit maximum cooperation in his acceptance of medical treatment. A further advantage of this procedure is that it will routinely acquaint each patient with the psychological staff, and this contact should make it easier for him to request help if and when he might feel a need for it.

It is further proposed that more intensive testing be used in evaluating patients referred by ward physicians for diagnosis or treatment. With the increase in staff, resulting in more time available for testing, and the

growing awareness of the use of tests on the part of the doctors, this aspect of the program should receive greater emphasis than it has in the past.

2) *Individual psychotherapy:* It was observed that an increasing number of patients were requesting individual treatment. It is believed that the service must continue to meet this need in those cases where specialized attention is necessary and where the ward physician cannot handle the problem himself. However, some compromise must be reached in terms of the time devoted to this function. It is proposed that this be effected by a careful selection of patients in which priority is given to those who feel an urgent need for help, and particularly to those having problems which are believed to be a serious hindrance to their medical treatment.

As a means of providing help to a larger number of patients, it is anticipated that the services of the staff will be directed toward assisting the doctor in applying psychological principles himself in his contacts with patients. In many cases, such treatment on the part of the ward physician would obviate the need for referral to the psychological service.

3) *Group psychotherapy:* The effectiveness and practicability of group psychotherapy with tuberculous patients has not yet been determined. Experience with groups at this hospital indicates that some modification of the traditional role of the therapist, and of those techniques found to be effective with neurotic patients, may be indicated. It is therefore proposed that, as other groups are formed, the leaders should be ready to assume greater responsibility for the discussion. Interpretation of feelings and interpersonal relationships will be less emphasized than the giving of information and support, at least in the early stages of treatment. In any case, continued study is needed to determine what adaptations of the usual group-therapy techniques may be indicated in the treatment of tuberculous patients.

4) *Relationship with patients:* The improvement in attitude on the part of patients toward the psychological service has given support to the plan whereby referrals were accepted only for those who expressed a willingness to be tested or interviewed. No change in this general approach is contemplated. It is anticipated that the admissions program and the recommendations of patients who have received help will make known to each patient, and more acceptable to him, the service which is available.

5) *Relationship with staff:* It was believed that winning acceptance for the psychological program on the part of the medical staff required establishing good relationships with them on an individual basis. Although to a large extent this has been accomplished, many physicians are still not adequately acquainted with the activities of the service in a professional sense, and the various ways in which it can be of assistance to them. It is planned, therefore, that the psychological staff will give special attention to referrals and informal conferences where the psychological report may have a direct bearing on medical plans for treatment, and particularly where some evidence of the validity of the findings can later be made available.

The report on each incoming patient will be delivered personally to the

physician on the receiving ward and to the physician on the ward to whom the patient is later transferred for long-term care. Discussion will be encouraged, and suggestions will be made as to how the doctor himself can best deal with the patient. Where a recommendation for psychotherapy has been made, the basis for such recommendation will be explained, ways of suggesting this treatment to the patient can be discussed, and the progress of patients undergoing treatment can be reported. Such communication through written reports and through personal interviews with the doctors should do much to facilitate a team approach to the problems encountered.

Since there are no formal meetings of professional personnel where the various medical, psychological and social aspects of a case can be jointly considered, it has been decided that a weekly psychosomatic conference will be scheduled. The referring physician will present his reason for referral and the pertinent medical history. The social worker assigned to the case will present the social history, and the psychologist will discuss the results of psychological testing. Others having knowledge of the patient will be invited to attend and to contribute what information they may have. Discussion will be led by the psychiatrist who will add his own interpretation of the data. A diagnosis and recommendations for treatment will then be made. It is believed that this conference will result not only in a more complete understanding of the patient, but also in a clarification of the functions of each professional group. Emphasis on the team concept should lead to better coordination among the various services and to a more integrated approach to the treatment of patients with emotional problems.

6) *Research:* In the literature pertaining to the psychological aspects of tuberculosis, many statements are made regarding the importance of emotional factors in the etiology and treatment of the disease. Very few of the studies reported, however, are based on objective data, and an experimental investigation of the numerous opinions expressed is needed to determine their validity.

It is contemplated that research will be incorporated as a major function of this program. Test data and interview material on new admissions will be immediately available, and will have the advantage of representing an unselected group of subjects, all of whom are in the initial stage of treatment. This material can be used to determine whether there are psychological patterns characteristic of tuberculosis patients, in contrast to corresponding findings for other chronically ill groups and for normals. It might also be used in making predictions regarding individual response to treatment. Eventually, the results of such studies should suggest specific psychotherapeutic procedures best adapted to the treatment of these patients which would substantially affect their rate of recovery.

Present Status

A number of the foregoing plans for further development of the psychological program have already been put into effect: Two psychology trainees have been added to the staff; new admissions are routinely tested

with a battery of psychodiagnostic tests; individual psychotherapy has been supplemented by assisting the physician in applying psychological principles himself; and regular psychosomatic conferences have been inaugurated.

As the program continues to expand, it is anticipated that the contribution of this type of service will become increasingly more apparent, and that psychological methods developed through experience and research in this hospital will be applicable in others where the primary concern is that of treating the tuberculous patient.

SUMMARY

Experiences encountered during the first six months of a psychological service in a Veterans Administration tuberculosis hospital are described as follows:

1) The staff consisted of one full-time clinical psychologist and one part-time psychiatrist.

2) Activities engaged in were psychodiagnostic testing, individual and group psychotherapy, teaching, and consultation. A proportionately large share of staff time was devoted to individual psychotherapy, requests for which outnumbered those for other types of service.

3) Treatment of patients with group psychotherapy suggested a need for modification of this technique in its application to tuberculous patients.

4) The attitude of patients toward the service was generally favorable, although resistance was encountered which might be expected in any non-psychiatric setting.

5) The need for a closer working relationship with the medical staff and other hospital personnel was discussed.

6) Plans for expansion of the program were described as follows: Assignment to the hospital of psychology trainees, testing and interviewing of all newly admitted patients, organization of this data for research purposes, scheduling of a weekly psychosomatic conference, and emphasis on consultation with the ward physicians in order to work indirectly through them in the psychological treatment of patients.

RESUMEN

Se describen los resultados de la experiencia durante seis meses en el servicio de psicología en un hospital de tuberculosos de la Administración de Veteranos.

1) El personal consistió en un psicólogo clínico a tiempo completo y un psiquiatra a tiempo parcial.

2) Las actividades emprendidas fueron pruebas psicodiagnósticas, enseñanza y consulta. Una parte proporcionalmente grande del tiempo del personal se dedicó a la psicoterapia individual. Las demandas de esta actividad sobrepasaron a otras formas de trabajo.

3) El tratamiento de los enfermos por la psicoterapia sugirió la modificación de esta técnica para los enfermos de tuberculosis.

4) La actitud de los enfermos ante este servicio fué en general favorable

aunque se encontró alguna resistencia como podría esperarse en cualquier grupo no psiquiátrico.

5) Se discute la necesidad de una relación mas estrecha entre el personal médico y el resto del personal del hospital.

6) Se describen los planes para la expansión del plan como sigue: Asignación de personas preparadas en psicología para el hospital, pruebas y entrevistas para todos los nuevos enfermos admitidos, organización de los datos obtenidos con propósitos de investigación, plan de una conferencia psicosomática semanaria, y se recalcó la necesidad de una consulta con los médico de las salas a fin de trabajar indirectamente por medio de ellos en el tratamiento psicológico de los enfermos.

RESUME

Les auteurs décrivent les expériences qu'ils ont pu faire dans les six premiers mois de l'établissement d'un service d'études psychologiques dans un hôpital pour tuberculeux de l'administration des Vétérans.

1) Les responsables de cette étude comprenaient un "psychologue de clinique" à temps complet et un psychiatre à temps partiel.

2) Les moyens utilisés furent les tests psychodiagnostiques, la psychothérapie individuelle et la psychothérapie de groupe, l'enseignement et la consultation. Le personnel consacra un temps relativement important à la psychothérapie individuelle; celle-ci se montra nécessaire dans un nombre de cas beaucoup plus important que dans d'autres services.

3) Le traitement des malades par la psychothérapie de groupe exigea l'adaptation de ce procédé au malade tuberculeux.

4) Le comportement des malades à l'égard de cette institution était généralement favorable, malgré qu'on ait rencontré la résistance qu'on peut attendre de n'importe quel traitement, même non psychiatrique.

5) Les auteurs discutent la nécessité de relations pour un travail plus intime avec l'ensemble du corps médical et le reste du personnel de l'hôpital.

6) Les directives pour exécuter ce programme furent les suivantes: présence à l'hôpital de moniteurs de psychologie, interrogatoire et test de tous les nouveaux malades admis, organisation de ces principes dans un but de recherche, projet d'une conférence psychosomatique hebdomadaire; ils mettent l'accent sur la nécessite d'une coopération avec les autres médecins, afin de pouvoir indirectement par leur intermédaire réaliser un traitement psychologique du malade.

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The Reliability of Chest Roentgenography and Its Clinical Implications*

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The interpretation of chest roentgenograms, like any other human activity, is subject to considerable variation. It has been demonstrated that competent and experienced physicians are likely to disagree with each other in a significant proportion of roentgenographic interpretations. These inconsistencies were found when single roentgenograms were interpreted for the presence or absence of abnormal shadows. Even greater discrepancies were demonstrated in attempts to classify single roentgenographic shadows according to character, extent, and probable "activity" of the lesion. The implications of these findings to mass case finding programs have been discussed in a number of publications.[1-5]

More recently inconsistencies of similar magnitude were found to exist in the interpretation of serial roentgenograms. It was shown that in evaluating film pairs for evidence of progression, regression, or stability of disease, well qualified radiologists and phthisiologists disagreed significantly with each other. Moreover, a physician did not always agree with himself in two independent interpretations of a set of serial roentgenograms.[6] These findings are of great importance in clinical phthisiology in view of the universal employment of the procedure as an aid in the clinical management of tuberculosis patients.

It is no doubt superfluous to state that, in spite of these difficult problems of interpretation, serial roentgenograms are among the most valuable criteria for assessing the course of disease in a patient with pulmonary tuberculosis. The most reliable estimate of changes in the extent and character of a lesion is provided by roentgenography and is perceived by a comparison of serial chest films. The evidence provided by roentgenography, however, must be integrated with other clinical findings and results of other tests. For the proper evaluation of these, and for the derivation of the most probable diagnosis, it is desirable to have knowledge of the limitations of each test. What is wanted is a quantitative evaluation of the errors inherent in each. Unfortunately, our knowledge of the subjective error in clinical medicine and of the variations in the different diagnostic tests is meager. The quantitative data which have recently been accumulating on the evaluation of roentgenographic interpretations are, it may be hoped, the forerunner of similar data which will be forthcoming in other fields of medicine.

One of the advantages which results from the demonstration of the existence of observer errors is the stimulation which it provides for devising

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methods to reduce them. From a long range point of view, reductions in these errors will occur as the art and science of radiology is progressing and improving. However, more immediate benefits may be derived from attempts to utilize such knowledge as is presently available to increase the reliability of roentgenographic interpretation. Thus, it has been demonstrated that in case finding programs the disadvantages resulting from errors in interpretation can be significantly reduced by the method of dual reading of all survey photofluorograms.

In view of the demonstrated error in the interpretation of serial roentgenograms, it is pertinent to inquire whether in clinical phthisiology also, dual reading may increase the reliability of film interpretation. In other words, is there a modification of the procedure of dual reading which may be applied to serial roentgenograms and which will reduce the errors of interpretation?

TABLE I

INTER-INDIVIDUAL VARIATION

Comparison of the First Readings on the 1,807 Photofluorograms (70-millimeter) of Each Reader with Those of Every Other Reader and the Per Cent Disagreements Between Readers Based on all Films and on Films which were Called Positive by at Least One of the Two Readers

Readers	Number of Films on Which the Two Readings Were: Both negative (a)	One positive one negative (b)	Both positive (c)	Number called positive by at least one reader (b plus c) (d)	Per Cent Disagreement Based On: All films (b/1,807) x 100 (e)	Films called positive by at least one of the two readers (b/d) x 100 (f)
A and B	1,732	56	19	75	3.1	74.7
A and C	1,728	54	25	79	3.0	68.4
A and D	1,694	87	26	113	4.8	77.0
A and E	1,724	59	24	83	3.3	71.1
A and F	1,694	90	23	113	5.0	79.6
B and C	1,742	46	19	65	2.5	70.8
B and D	1,709	77	21	98	4.3	78.6
B and E	1,738	51	18	69	2.8	73.9
B and F	1,712	74	21	95	4.1	77.9
C and D	1,706	73	28	101	4.0	72.3
C and E	1,735	47	25	72	2.6	65.3
C and F	1,709	70	28	98	3.9	71.4
D and E	1,701	80	26	106	4.4	75.5
D and F	1,678	97	32	129	5.4	75.2
E and F	1,703	79	25	104	4.4	76.0
Mean	1,713.7	69.3	24	93.3	3.8	73.8

It is the object of this paper to present the results of an investigation of the role of dual reading in clinical phthisiology. The findings on the variation in interpretation of single and serial roentgenograms are reviewed, and data are provided on the basis of which it is possible to determine what may be gained from the procedure of subjecting all serial films to two independent interpretations.

Previous Studies

Investigations on the reliability of roentgenographic interpretation relate to the following general topics: (1) Detection of lesions. (2) Description and classification of a lesion. (3) Serial roentgenograms, and (4) Dual reading of single roentgenograms. It may be well to review briefly the results of the investigations in these fields as background for evaluation of dual reading of serial roentgenograms.

Detection of Lesions: When a group of roentgenograms is submitted to several investigators for interpretation as to the presence or absence of a shadow suggestive of inflammatory disease, the results vary widely.[1-5] Considerable variation is noted also when the same reader interprets the films independently twice on two different occasions.

The magnitude of inconsistency of interpretation may be judged from the results of one of the investigations.[4] In that study 1,807 miniature survey films on unselected entering students were interpreted by six competent readers.

The results of the 15 comparisons of the six readers, each paired against the other, are shown in Table I. It may be seen that on the average two readers agreed that the film was "negative" in 1,714 cases, that it was "positive" in 24 cases, and in 69 films there was disagreement: one reader called the film "positive" and the other "negative." The percentage disagreement may be computed in two ways. The 69 disagreements may be divided by the 1,807 film pairs, yielding a 3.8 per cent disagreement. However, if attention is focused, as it generally is, on the positive films, a much more disturbing picture emerges. Thus of the 93 films which were considered positive by at least one of the readers, disagreement occurred in 69 cases (75 per cent).

Measures of inconsistencies as given above may be useful but they are limited in that they reflect a combination of two factors: "false-positive" and "false-negative" errors. More useful are separate measures of these two factors. Thus the "false-negative" error was found to be approximately 32 per cent. That is, a reader misses 32 per cent of films which are "truly positive" (in the sense that they possess x-ray evidence of inflammatory disease requiring further follow-up). The "false-positive" error is around 1.7 per cent. In other words, a reader will give a "positive" diagnosis on 1.7 per cent of films which are "truly negative" (in the sense that they do not contain evidence of inflammatory disease). These results are not limited to the miniature 70 mm. films. Similar findings were recorded for the other film sizes including the 14 x 17 inch celluloid films.[1]

Description and Classification of a Lesion: Much more serious discrepancy

than that found in studies on detection of lesions was found in evaluating the reliability of describing and classifying roentgenographic lesions. This is obviously a much more difficult activity and its unreliability should have been suspected from a knowledge of the variation in classifying objects which are much more tangible than a shadow on an x-ray film. It is surprising, therefore, that until recently practitioners in this field were convinced that they were able to interpret a lesion not only as to its probable significance at the moment, but also as to its prognosis. In fact, a large segment of physicians practicing in this field still believe that they can do it.

A number of studies were inaugurated and nearly all methods of describing and classifying lesions were tested. A detailed analysis of the findings in this field has just been completed by Newell and associates.[7]

A summary of some of the results was generously supplied by R. R. Newell and is presented in Table II. In this table three methods of classification of lesions are tested. In the first set (A) the reliability of interpreting "activity" of a lesion from a single x-ray film is tested. The evaluation of consistency in the use of the term "active" errs on the conservative side; first, by limiting the analysis to such shadows which in the first instance were classified as reinfection tuberculosis by both readers; secondly, by excluding lesions which were called "questionably active" by any reader. In other words, in the figures presented in the table, a disagreement was counted only when one person called the lesion "reinfection tuberculosis active" and the other called it "reinfection tuberculosis in-

TABLE II: CONSISTENCY IN THE USE OF CERTAIN SYMBOLS IN X-RAY INTERPRETATION

Observed per cent agreement between two readers in employing specific symbols and per cent agreement expected by chance in independent interpretations of three sets of x-ray films by three radiologists

Set	Symbol	Per cent of lesions on which symbol was used	Per cent agreement between two readers		Ratio of Observed to Expected
			Observed	Expected	
A	Active*	42.1	51.4	26.8	1.92
	Inactive	57.9	62.2	40.9	1.54
B	Fibrotic	54.5	43.8	36.7	1.19
	Soft	60.6	71.6	40.6	1.76
	Hard	54.5	46.6	35.3	1.32
	Cavity	14.4	51.9	7.0	7.41
	Nommular	8.3	100.0	3.1	32.3
C	Checkered	62.0	59.3	42.4	1.40
	Spotted	32.9	29.5	18.9	1.56
	Honeycombed	23.7	25.0	12.4	2.02
	Smooth Matrix	23.2	44.9	12.5	3.59
	Unclassified	38.2	39.2	24.6	1.59

* The analysis of activity was limited to lesions which were classified as reinfection tuberculosis by both readers, and excludes also such films which were classified as of "questionable activity" by any reader.

active." It will be seen that even under these conditions the agreement between two readers in the use of the classification "active" was only 51.4 per cent. On the basis of chance alone it could be expected that agreement in the use of the symbol would occur in 26.8 per cent of the lesions. Thus agreement is better than expected by chance and therefore it can be stated that the term possesses some discriminatory power but the low percentage agreement indicates that it is not useful.

Similar findings may be noted for the other methods of describing lesions (Sets B and C). The percentage agreement between two readers for the different terms is relatively low. The only exception is for the term "nomular" for which the agreement was 100 per cent. This term, however, is used only rarely. From the last column, which presents the ratio of the observed agreements to those expected on the basis of chance alone it is possible to array the different terms as to their discriminatory powers. Thus the term "cavity" has a high ratio of observed to expected agreement. However, the percentage observed agreement (52) does not appear high enough to be useful. The same applies to the terms "smooth matrix" and "soft." Most of the other terms as well as many other methods of classification have discouragingly low percentages of agreement.

Serial Roentgenograms: Discouraging as the results of interpreting single x-ray films are, they provide less of a shock to clinicians than the findings that the interpretations of serial roentgenograms are also grossly inconsistent. A comprehensive analysis of the interpretation of serial roentgenograms was conducted by six competent physicians, three of them radiologists and three phthisiologists. They interpreted 150 pairs of 14 x 17 inch anterior-posterior x-ray films taken on tuberculosis patients at three-monthly intervals and attempted to classify the pairs in only three groups: "better," "no change," and "worse." Later, each physician interpreted the same set a second time.[6]

The main findings of that study are shown in Table III. It will be seen that *in judging a pair of x-ray films for evidence of progression, retrogression, or stability of disease, two readers are likely to disagree with each other in about one third of the cases and a single reader is likely to disagree with himself in about one fifth of the film pairs.* This demonstration of unreliability of interpretation of serial x-ray films is in many respects much more serious than that of the unreliability of interpreting single

TABLE III

Percentage of Disagreement Between Readers (Inter-Individual) and for an Individual Reader with Himself (Intra-Individual) in Interpreting 150 Film Pairs (Diagnosis Based on Entire Lung Field)

Comparisons which were:	INTER-INDIVIDUAL		INTRA-INDIVIDUAL	
	Number	Per cent	Number	Per cent
Disagreements	2,686	30.1	192	21.5
Agreements	6,245	69.9	701	78.5
TOTAL	8,931	100.0	893	100.0

roentgenograms because of its wide use in clinical phthisiology. Many a decision affecting the patient often rests on the interpretation of change as seen on two films taken at different times.

Dual Reading of Single Roentgenograms: It has been shown that the method of dual reading will reduce the undesired effects of unreliability of x-ray film interpretation in mass case finding programs. The main feature of the method is that of submitting all the photofluorograms to two independent readings. On *a priori* grounds it may be seen that such a method is a two-edged sword. While it may be expected to reduce the proportion of "positive" films which are missed, it will, at the same time, increase the number of "false-positive."

In studying the problem it is therefore necessary to evaluate the benefits gained by the procedure against the penalty paid for it. Such an evaluation has been made[4] and a summary of the results is shown in Table IV which is constructed on the basis of a survey of approximately 6,000 persons including 100 individuals who are roentgenographically "truly positive." The table shows that a single reader detects only 68 of the 100 "truly positives" and misses 32. He bothers unnecessarily 99 individuals; that is,

TABLE IV

SUMMARY TABLE: COMPARISON OF SINGLE READING AND THE DIFFERENT METHODS OF DUAL READING

Number of "Truly Positives" Detected and Number of "Truly Negatives" Diagnosed Falsely as Positive in a Hypothetical 70-Millimeter Survey of a Group of 5,967 Persons. This is an Extrapolation from a Real Group of 1,790 Persons Presenting 30 "Truly Positive" Films to a Group Sufficiently Large to Present an Even 100 "Truly Positives" (Exclusive of Questionable Films)

Method of Reading		SURVEY OF 5,967 PERSONS CONTAINING 100 "truly positives" Number of "truly positives" detected a	100 "truly positives" Number of "truly positives" missed b	5,867 "truly negatives" falsely diagnosed as positive Number c	5,867 "truly negatives" falsely diagnosed as positive Per cent (c/5,867) x 100 d
Single reader		68	32	99	1.7
Two readers (one *or* the other)		79	21	192	3.3
Two readers (*both* agreed)		57	43	6	0.1
Panel of three; two readers in agreement plus review of disagreements when the decision of the panel was	Positive by unanimous opinion	75	25	72	1.2
	Positive by at least one reader	78	22	107	1.8
"Panel" of one; two readers in agreement plus review of disagreements by a single reviewer	Average of five performers	74	26	83	1.4
	Average of two performers	78	22	99	1.7

he gives "false-positive" diagnoses on 1.7 per cent of the "truly negatives." If the 6,000 films were subjected to dual reading, and if each person who was called "positive" *on one or the other* of the two readings were called back for further examination, 79 of the "truly positives" would have been detected and only 21 would have been missed. However, 192 "false-positives" would have been troubled compared to 99 such cases called by a single reading. If only those that were called "positive" on *both readings* were called back for further examination, only 57 of the 100 "truly positives" would have been detected, but there would have been practically no "false-positives" called back.

It is seen therefore that dual reading can be used in a number of different ways. Under one scheme more of the "truly positives" would be detected but at the same time more "false-positives" would be bothered unnecessarily. Under another scheme, the problem of "false-positives" could be eliminated but at the expense of missing more of the "truly positives."

The lower part of Table IV presents methods of using dual reading whereby the benefits are retained at no extra penalty. This is accomplished by subjecting the films with contradictory interpretation to another reading. It will be seen that this method retains the advantage of dual reading in the terms of "truly positives" detected without having to pay an extra penalty in terms of additional "false-positives" called back.

Material and Method

The evaluation of the role of dual reading in reducing the inconsistencies in serial x-ray film interpretation is based on the same material that was used in the previous investigation on serial roentgenograms.[6] The material consists of 150 pairs of x-ray films taken on patients with proved tuberculosis. The interval between the two films of a pair was approximately three months. These 150 film pairs were interpreted by six qualified and experienced specialists, three radiologists and three phthisiologists.*

The method of classification was of the simplest possible kind. That is, each pair was diagnosed in one of the three groups: "better," "no change," and "worse." Each reader interpreted the 150 pairs on two different occasions independently, that is, without knowledge of his own previous readings or of the readings of the other five interpreters. These interpretations were found adequate in the previous investigation for determining the amount of agreement between different readers and between the two readings of the same interpreter.

For the purpose of studying the advantages and disadvantages of dual reading of serial roentgenograms, the material as it stands is not sufficient. In addition, it is necessary to determine for each film pair the probable "true" situation in regard to change. The objective of dual reading is obviously not so much to reduce disagreement as it is to increase as far as

*The phthisiologists were Drs. Sidney J. Shipman, University of California, H. Corwin Hinshaw, Stanford University, and James T. Harkness of Cowell Hospital of the University of California. The three radiologists were Drs. L. Henry Garland of Stanford University, Earl R. Miller of the University of California, and Henry Zwerling of Alta Bates Hospital.

possible the number of correct diagnoses. It becomes necessary therefore to attempt to determine independently as nearly as possible what the correct diagnosis on each pair is. It should be emphasized here that what is looked for is a method for defining the "true" *roentgenographic* status, not the *clinical one*. The objective of serial films is to obtain a roentgenographic evaluation of the progress of disease in the patient, not a clinical evaluation. The latter is determined by several criteria of which serial roentgenography is only one, albeit a very important one. What is of real significance is to devise a method whereby the *radiological interpretation* of the changes in the shadows on the two x-ray films is as reliable as possible. Consequently the determination of the probable "true" status of each film pair, in this study, cannot rest on the clinical data which may be available about the individual, but must be based entirely on the evaluation derived from the roentgenograms themselves.

In the present study the determination of the "correct" or "true" radiological status of each pair of films was accomplished by the following procedure. From the previous study there were available for each film pair 12 independent interpretations. If at least eight of these 12 were in agreement on a given category, that one was taken to represent the probable "true" status for that pair. All the film pairs which did not meet this criterion were resubmitted to the same group of radiologists and phthisiologists at a group meeting.*

The procedure in the group review was as follows: each member first interpreted each pair independently. After each man announced his own interpretation, a general discussion ensued with the aim of arriving at a unanimous decision on what the most probable "true" category is. When such unanimity was obtained the agreed-on category was accepted. However, this was not possible for all film pairs. In eight cases there was still disagreement even after extensive discussion. These eight pairs are excluded from the present study. The material available for study consists therefore of 142 film pairs on which a definite category is available. As a result of the group discussion, these 142 were placed in the following groups: 63 represent radiological evidence for "better," 59 for "no change" and 20 for "worse."

With this knowledge about the probable "true" status of each film pair, it becomes possible to investigate the original interpretations of the six physicians. Comparisons can now be made between the number of "true" and "false" diagnoses given by a single reader and those provided by dual reading.

When a pair of roentgenograms is submitted to two independent interpretations, two situations may arise. One in which the two readings are identical, the other where the interpretations place the film pair in two different categories. In the first instance, the course of action is, at least, definite and, as will be shown later, reliable. In the second case, no definite action with regard to the film pair is possible. For example, if the film pair

*Dr. Hinshaw of the original group was unable to attend that meeting and Dr. Harold G. Trimble kindly consented to review the films in his place.

has been interpreted as "better" in one reading and as "no change" in the other, then at most, it can be said that, radiologically, the patient is not getting "worse." Even such a statement cannot be made in situations where one reading is that of "better" and the other is that of "worse."

It is, of course, possible to submit these questionable cases to a third interpretation with the hope that the third reader will agree with one or the other of the two readings and thus provide a more reliable basis for action. The material available for the present study makes possible the evaluation of the advantages and disadvantages of the initial dual reading as well as the submission for a third reading of the film pairs with contradictory diagnosis.

Dual Reading of Serial Roentgenograms

The 142 film pairs which form the basis for the present study represent a somewhat easier set than the original group of 150 pairs, since the eight pairs which have been eliminated represent the more complicated and difficult pairs of the set. In fact the percentage disagreement between readers in their original interpretations was only 28.3 on this set, compared to 30.1 on the 150 film pairs (Table III). In terms of the known "true" diagnosis, a single reader, on the average, was found to be correct in 114.8, and to give a "false" diagnosis in 27.2 of the 142 film pairs. In other words, a single reader is correct in his interpretations 80.8 per cent of the times and gives a wrong diagnosis approximately one time out of five.

With these data as background, it now becomes possible to determine what are the benefits and disadvantages of dual reading of serial roentgenograms. When the interpretations of two readers on these 142 film pairs are considered, it is found that, on the average, they agreed on 101.3 and disagreed on 40.7 film pairs. The important and striking result is that of the 101.3 instances in which the two readers gave identical readings, that reading was the "true" one in 95.4 cases and was "false" in only 5.9. In other words, *when two readers place a film pair in the same category, there is a very high probability that that category is the "true" one.* This, therefore, is the greatest advantage of dual reading. That is, it provides a means of identifying the two thirds of the film pairs on which a diagnosis can be

TABLE V: ALL FILM PAIRS

The Number and Percentage of Definite Diagnoses ("True" or "False") and Disagreements on Diagnoses as Determined by Two Identical Readings or by Two Different Readings Respectively by the Same (Intra-Individual) or Two Different Readers (Inter-Individual) Interpreting the Film Pairs

Type of Diagnosis	INTER-INDIVIDUAL		INTRA-INDIVIDUAL	
	Number	Per cent	Number	Per cent
Definite Diagnosis "True"	95.4	67.2	100.5	70.8
Definite Diagnosis "False"	5.9	4.2	11.8	8.3
Disagreements on Diagnosis	40.7	28.7	29.7	20.9
TOTAL	142	100.0	142	100.0

given with considerable confidence. The penalty paid for this benefit is that for about 29 per cent of the film pairs no definite diagnosis can be given without further investigation; because on this percentage of cases the two readings are in disagreement (See Table V).

The results are somewhat different when the two readings are provided by the same reader. Thus, on the average, the two readings by the same

TABLE VI

DEFINITE DIAGNOSIS BY A SINGLE READER OR TWO READERS

An Estimate of the Number of "True" Diagnoses and "False" Diagnoses of Two Readings by the Same Reader or by Two Different Readers on a Set of 100 Film Pairs on which the Two Readings of the Reader or Readers Were Identical; On 100 Pairs of Films the Number of "True" Diagnoses and "False" Diagnoses when a Single Reader Interprets the Film Pairs

Type of Diagnosis	DUAL READING		Single Reading
	Inter-Individual	Intra-Individual	
"True" Diagnoses	94.2	89.5	80.8
"False" Diagnoses	5.8	10.5	19.2

TABLE VII

DISAGREEMENTS ON DIAGNOSIS BY TWO READERS

Of the Film upon which Two Different Readers Disagree on Diagnosis, the Number and Percentage of "True" Diagnoses and "False" Diagnoses Occurring if a Third Reader Interprets the Film Pairs and the Diagnoses are Based on Two out of Three Readers Agreeing

Type of Diagnosis	Two out of Three Readers Agreeing	
	Number	Per cent
"True" Diagnoses	28.2	69.3
"False" Diagnoses	8.8	21.6
TOTAL	40.7*	100.0

*The total includes 3.7 cases on which the three readers disagreed.

TABLE VIII: SUMMARY TABLE: COMPARISON OF SINGLE READING AND THE DIFFERENT METHODS OF DUAL READING

A comparison of the number of "True" diagnoses, "False" diagnoses and disagreements on diagnoses on 100 film pairs which have been interpreted by different methods of dual reading

Method of Reading	Of 100 Diagnoses the Number of		
	"True" Diagnoses	"False" Diagnoses	Disagreements on Diagnoses
Single Reader	80.8	19.2	—
Dual Reading:			
Same Reader	70.8	8.3	20.9
Two Different Readers	67.2	4.2	28.7
Two Readers in Agreement Plus Review of Disagreements	87.0	10.4	2.6

individual will be identical in 112.3 film pairs and they will be in disagreement in 29.7 pairs. However, of the film pairs with identical readings the diagnosis will be "false" 11.8 times out of the 112.3 (see Table V). In other words, when dual reading is performed by a single reader the number of questionable cases is smaller than that when the reading is done by two different readers. However, the degree of confidence which may be placed on the identical reading provided by the same individual is not as large as that when the two identical readings are provided by two different readers.

Leaving out of consideration, for the moment, those cases which provide different interpretations in two independent readings, it is possible to summarize these results as is shown in Table VI. Thus a single reader provides "false" diagnosis in one out of five film pairs. Two readings, when performed by two different individuals, will be "false" one time out of 20, while dual reading performed by a single individual will be "false" in one out of 10 film pairs.

It now becomes necessary to investigate what, if anything, may be gained if the 40.7 film pairs which were diagnosed differently by the two readers are subjected to a third interpretation. In most instances the third interpretation will agree with one or the other of the two initial readings. If the policy is followed to consider the interpretation provided by two out of three as the "correct" one, then the 40.7 film pairs will distribute themselves as is shown in Table VII. Thus, in 28.2 instances, the category provided by two out of the three readers will be the "true" diagnosis and in 8.8 film pairs the two will agree on the "false" diagnosis. It is of interest that in 3.7 cases the third diagnosis will agree with neither of the two.

It is now possible to summarize the results to be anticipated in the interpretation of 100 pairs of roentgenograms by a single reader or by dual readings. This is shown in Table VIII. Thus a single reader will provide 80.8 "true" and 19.2 "false" diagnosis. Dual reading by two different individuals will place 67.2 of the 100 film pairs in the "true" category, 4.2 in the "false" category, and 28.7 in an indeterminate group. When dual reading is performed by the same reader 70.8 of the films will be placed in the "true" category, 8.3 will be falsely diagnosed, and 20.9 film pairs will remain in a questionable category.

If the 28.7 pairs with questionable diagnosis are submitted to a third interpretation, the entire 100 film pairs will now be placed as follows: approximately 87.0 film pairs will now be correctly diagnosed, on 10.4 pairs the diagnosis will be "false," and 2.6 will remain "indeterminate."

Discussion

The relatively large subjective error in the interpretation of serial x-ray films presents a serious problem in clinical phthisiology. The estimate of change, as revealed by a comparison of two roentgenograms taken on the same patient at different times, is very useful to the clinician for evaluating the progress of disease in the patient. It is therefore of extreme importance that the estimate be as reliable as possible. The finding that two competent physicians are likely to disagree in as many as one third of the cases and

that a single interpreter may disagree with his previous reading in one fifth of the pairs, points up the need for serious attempts to improve the reliability of serial x-ray film interpretation. The situation would not have been so serious if it were possible to identify *a priori* the difficult and easy film pairs. In other words, if it were possible to determine the film pairs on which there will be general agreement on diagnosis and those pairs on which readers will be likely to disagree, then it would have been possible to provide a diagnosis on the first group with considerable confidence and to reserve judgment on the more difficult films. Unfortunately, this identification is a very difficult if not an impossible task.

In a previous study[6] it was shown that *"a reader was unable to agree with other readers or with himself as to which of the pairs of films were difficult."* This difficulty of identifying "easy" films was strikingly demonstrated recently at a meeting of the California State Tuberculosis and Health Association. Two film pairs were shown to some 50 physicians. The readers were asked, first, to express their opinion on each pair, whether it was easy or difficult to diagnose, and then to classify the film pair in one of the three categories of "better," "no change," or "worse." The results of that little experiment are shown in Table IX. It is seen that film pair No. 1 was thought to be "easy" by 37.8 per cent of the doctors while film No. 2 was thought to be "easy" by 55.9 per cent of the physicians. On this basis it would appear that film pair No. 2 was easier of diagnosis than was film pair No. 1. The performance of the same physicians on these films, however, belied that statement. For, on the presumably "easy" film the per cent disagreement was 52.2, while on the relatively more "difficult" film pair the disagreement was only 37.8 per cent. Moreover, in no instance was there a complete reversal (that is from "better" to "worse") on the "difficult" film, while on the "easy" film pair complete reversals occurred in 38.9 per cent of the comparisons.

It is this inability to separate the "easy" from the "difficult" films which is so disturbing; because the insecurity and doubt must now relate to all the film pairs. Consequently the radiologist or phthisiologist expressing an opinion on *any film pair* must be prepared to be contradicted by his col-

TABLE IX

On Two Pairs of Films, the Number and Per cent of Readers who Thought the Film Pairs to be Easy or Difficult and the Percentage Disagreements on these Film Pairs

Case Number	NUMBER OF READERS CALLING FILM			Per cent of Readers
	Easy	Difficult	Total	Calling Film Easy
1	17	28	45	37.8
2	24	19	43	55.8
Case Number	PERCENTAGE DISAGREEMENT			
	Simple Disagreements	Complete Reversal		Total
1	37.8	0		37.8
2	13.3	38.9		52.2

league approximately one third of the times. It is in this area that dual reading of serial x-ray films makes the greatest contribution.

When film pairs are submitted to dual reading, two thirds of the pairs are immediately identified as "easy." That is, approximately this many pairs will have identical diagnoses by the two readers, and the agreed-on category will be the "true" one in a very large majority of cases. The diagnosis on these two thirds of cases can be given with a great degree of confidence and assurance.

The procedure of dual reading identifies also the remaining one third of the film pairs as "difficult" of diagnosis. With regard to these, two modes of action are available. The first, and probably the most sensible, is to leave them in the status of "roentgenographically indeterminate." In other words, on the basis of these x-ray films, roentgenography can contribute little to an estimate of probable change. After passage of some time, additional information may be provided by a third roentgenogram which will provide more definite information when compared to the present two.

The other action is to submit the films with inconsistent diagnosis to a third interpretation and to accept the results of two out of three agreements as the correct one. This will have the advantage of reducing the number of indeterminate diagnoses, but the confidence which can be attached to the diagnosis, although considerably greater than that attached to the interpretation of a single reader, is not as great as that attached to the film pairs which have identical diagnoses by two interpreters.

Whether the one or the other method of action is the more desirable, depends on factors beyond the scope of this study. Mostly it relates to the willingness, on the part of the radiologist, to withhold judgment on about one third of the cases. Actually, in most instances, he is able to make a definite statement, except that the statement is weaker. For example he can state that a given case is "at least not worse" in instances of disagreements of the kind of "better" and "no change."

Irrespective of what mode of action is taken as a result of the procedure, it would appear from the results shown in this study that dual reading has greater advantages. It may be hoped that in the future good clinical practice will dictate that all serial roentgenograms be interpreted independently by two competent readers.

SUMMARY

A review of recent studies on observer error in roentgenographic interpretation shows that it is of considerable magnitude. Competent radiologists and chest specialists miss as many as one third of roentgenograms with radiological evidence of inflammatory disease. Even greater discrepancies are found in the description and classification of x-ray shadows. These variations are not limited to the interpretation of single films, but are present also in reading serial roentgenograms. Thus in judging two anterior-posterior 14 x 17 inch celluloid films for evidence of progression, regression, or stability of disease, two competent physicians are likely to disagree with

each other in approximately one third of the pairs and a single reader is likely to disagree with his previous interpretation one fifth of the times.

It is suggested that all serial x-ray films in clinical practice be submitted to two independent readings by two competent readers. This procedure will identify two thirds of the films in which the two readers agree. The diagnosis on these film pairs can be given with a great degree of confidence. The remaining one third of the films may either be left as "roentgenographically indeterminate" or they may be submitted to a third interpretation.

Acknowledgment: The author wishes to express his indebtedness to the great contributions in this field which were made by three groups of cooperating radiologists and phthisiologists. These groups were composed of the following:

1) Drs. W. Edward Chamberlain, Robert R. Newell, and Leo Rigler.

2) Drs. L. Henry Garland, Earl R. Miller, and Henry B. Zwerling.

3) Drs. James T. Harkness, H. Corwin Hinshaw, and Sidney J. Shipman.

He also wants to express his appreciation to Dr. Harold G. Trimble for assistance in interpreting, in group conference, a set of serial roentgenograms and to Mrs. Ellen Morton for much of the statistical work of many of the studies.

RESUMEN

La revisión de los recientes estudios sobre el error del observador en la interpretación roentgenográfica demuestra que ese error es de magnitud considerable. Los radiólogos competentes y los especialistas del torex dejan escapar hasta un tercio de los roentgenogramas con evidencia de enfermedad inflamatoria. Aun hay mayores discrepancias en la descripción y clasificación de las sombras a los rayos X. Estas variaciones no estan limitadas a la interpretación de películas únicas sino que se extienden a la interpretación de series. Asi al juzgar dos películas de 14 x 17 pulgadas P. A. para la evidencia de progreso, regresión o estabilidad de la enfermedad, dos médicos competentes es muy posible que no estén de acuerdo en aproximadamente un tercio de los pares y un solo observador es posible que no esté de acuerdo con su propia previa interpretación en un quinto de las ocasiones.

Se sugiere que todas las series de películas de rayos X en la práctica clínica se sometan a dos lecturas independientes por dos observadores competentes. Este procedimiento identificará dos tercios de las películas en las que dos observadores estén de acuerdo. Los diagnósticos de estos pares de películas pueden darse con gran confianza. El tercio restante de las películas puede ser dejado como de "radiograficamente indeterminado" o puede someterse a una tercera interpretación.

RESUME

L'examen des études récentes portant sur l'observation d'erreurs dans l'interprétation de radiographies montre que celles-ci sont d'une importance considérable. Des radiologistes et des spécialistes des affections du thorax parfaitement compétents laissent passer un tiers des radiographies sur lesquelles existent des signes évidents d'altérations pathologiques. Des divergences encore plus grandes dans la description et dans la classification des ombres radiologiques ont été notées. Ces variations ne sont pas limitées

à l'interprétation de simples films, mais existent également lorsqu'il s'agit de la lecture de radiographies en séries. C'est ainsi que si l'on demande à deux médecins en présence de deux films pris en antéro-postérieure de donner leur opinion sur la progression, la régression ou la stabilité de la maladie, ils auront toutes chances d'être en désaccord dans environ un tiers des lectures. Un lecteur unique a des chances d'être en désaccord avec sa première interprétation dans un cinquième des cas.

Les auteurs proposent que toutes les séries de films radiologiques en pratique médicale soient soumises à la lecture séparée de deux médecins compétents. Ainsi seront d'abord classés les deux tiers des films, les deux lecturs étant d'accord pour ceux-ci. Dans ces cas, le diagnostic peut être donné avec une grande marge de sécurité. Le tiers restant des clichés pourra être considéré comms "radiologiquement non déterminé" ou être soumis à une troisième interprétation.

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"Initial Foci", a Special Group of Minimal Tuberculosis. Prognosis and Treatment*

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In the Diagnostic Standards of the National Tuberculosis Association, U. S. A., "minimal tuberculosis" is described in the following manner:[1] "Slight lesions without demonstrable excavation confined to a small part of one or both lungs. The total extent of the lesions, regardless of distribution, shall not exceed the equivalent of the volume of lung tissue which lies above the second chondrosternal junction and the spine of the fourth or body of the fifth thoracic vertebra on one side." Cases of this type have become increasingly common since the introduction of mass miniature radiography. On closer examination of these cases, it is, however, obvious that the changes in "minimal tuberculosis" vary quite considerably. They may be of exudative, of productive and fibrotic, of exudative-productive or of fibro-calcific type. It may, therefore, be considered impossible to determine a common prognosis and a uniform therapy for all cases of "minimal tuberculosis." In addition, age, sex, race, general and individual resistance, etc., strongly influence the development of tuberculosis and the therapeutic possibilities. In cases of "minimal tuberculosis" the nature of the changes must, therefore, be carefully stated, cases with identical changes collected and the prognosis and the therapy determined in each separate group. In my opinion, it is only in this way, that greater certainty can be achieved in this question.

Such a well delimited group of "minimal tuberculosis," was named by Malmros and myself in 1938 "initial foci." Radiologically these show great uniformity and, on the whole, this probably also holds true as regards the pathological-anatomical changes, which cause the deviations from the normal in the x-ray photographs. "Initial foci" constitute the *first* changes in post-primary pulmonary tuberculosis (Ranke's stages II and III), and they form the starting point for ordinary pulmonary tuberculosis. Thus, we are dealing here with incipient tuberculosis in its earliest form.

In order to be able to collect material of this type one of the two following methods may be employed. One consists of taking x-ray photographs at very short intervals of individuals with definite primary tuberculosis until, in some cases, changes of post-primary type develop. The other method, employed by Malmros and myself in an eight-year investigation[2,3] consists of following the development of tuberculosis the whole course from the primary infection until the development of post-primary pulmonary tuberculosis. We put under control for tuberculosis 3,336 individuals, of whom 2,902 were students at the University of Lund and 434 probationary nurses from the same town. X-ray photographs were taken

*Presented at the Second International Congress on Diseases of the Chest, American College of Chest Physicians, Rio de Janeiro, Brazil, August 24-30, 1952.

of all at the first visit so that a control material would always be available. Those who were tuberculin negative at the first testing to 1 mg. tuberculin (Mantoux) were retested with tuberculin once or twice annually. When a positive reaction developed later, x-ray photographs of ordinary size were taken, regardless of the expense (the investigation was carried out before the introduction of mass miniature radiography), with intervals of some weeks or months for a very long period. In all 151 cases of primary tuberculosis infection in adults were encountered in this way. In 104 of these cases the infection did not bring any sequelae other than that they became tuberculin positive. The others, 47 individuals, developed various forms of tuberculosis such as erythema nodosum, primary complex, tuberculous adenitis, pleurisy and miliary tuberculosis. Significant is that 19 of them developed post-primary tuberculous changes in the lungs. It is true, that the number is not large but, at the time when the investigation was published, it probably comprised the first group of cases where, in series of x-ray films the earliest post-primary pulmonary changes could be studied with certainty as regards appearance, site, prognosis and therapy.

I do not intend, in the present work, to account in detail for the observations made. They were published in 1938 and what was said then holds true today. A few words are, however, necessary. The earliest post-primary changes, the so-called initial foci, are minute (1-2 mm.) or small (>2-5 mm. in size) rather irregular spots, sometimes ill-defined, sometimes well-defined and with a tendency to coalesce. They are encountered most frequently in the supraclavicular region or the first intercostal space and develop probably haematogenously. They do not give rise to symptoms, erythrocyte sedimentation ratio is also, as a rule, quite normal, and they cannot, ordinarily, be diagnosed even if the physical examination is conducted with the greatest exactitude. Ordinary sputum samples are most frequently negative. Culture from gastric lavage, on the other hand, quite often renders growth of tubercle bacilli. "Initial foci" developed in our

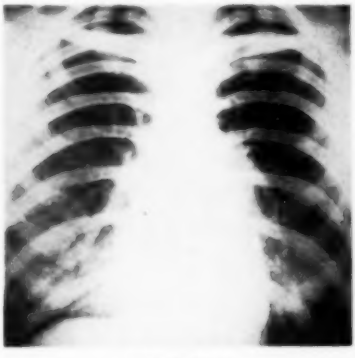

FIGURE 1

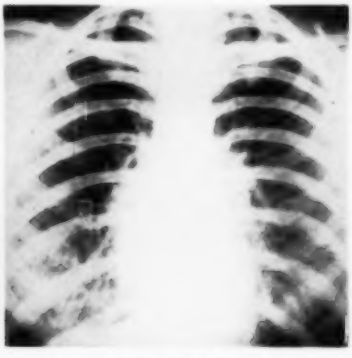

FIGURE 2

Figure 1, Case 1: Left-sided primary complex. — *Figure 2, Case 1:* Eight months later, initial foci in left supraclavicular region and second right intercostal space. Tubercle bacilli demonstrated. Later progression and sanatorium treatment.

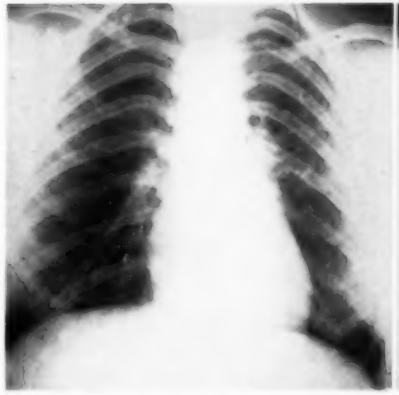

FIGURE 3

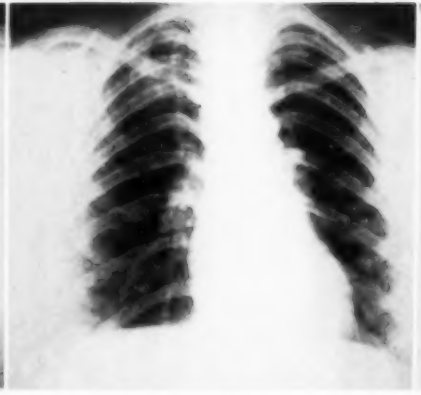

FIGURE 4

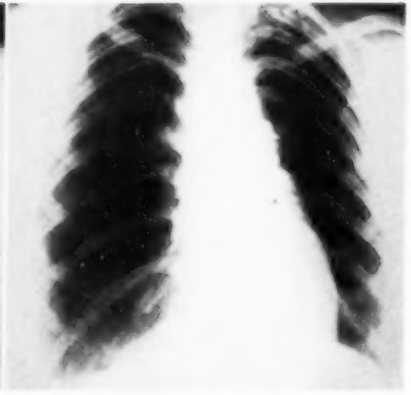

FIGURE 5

Figure 3, Case 2: Healed primary complex in left lung. Initial foci in both supraclavicular regions.—*Figure 4, Case 2:* Progression in right apex. Tubercle bacilli demonstrated. — *Figure 5, Case 2:* Right-sided artificial pneumothorax. Good collapse of the lung. Progression in left supraclavicular region. Cavity the size of a hazel nut. Later left-sided artificial pneumothorax also. Improvement.

material on the average 14 months after a negative tuberculin reaction and 12 months after a normal x-ray photograph. The "initial foci" may of course heal, indurate or become calcified. In the latter case they may give rise to the so-called Simon's apical foci. But they may also, and this is very common, after a shorter or longer period of quiescence show a progressive tendency. In this case fresh spots appear within the apical region or further down in the lung field; the oldest spots may simultaneously show a tendency to heal. In more rapid development, the spots coalesce, smaller or larger infiltrates develop, which later after caseation may give rise to cavities with secondary bronchogenic spread. Knowledge of this development is important. Far too frequently "initial foci" are misinterpreted. They are regarded as healed lesions or at least changes of no significance. Many of the cases encountered of this type are left, therefore, without control and return later with advanced pulmonary tuberculosis.

The prognosis of "initial foci" may be studied in the 19 cases mentioned which could be followed clinically and radiologically for the entire course from the primary infection until the development of ordinary pulmonary tuberculosis. Already in 1938, when the investigation was concluded, one of the 19 cases had died from pulmonary tuberculosis, five had developed such severe changes that artificial pneumothorax therapy had proved necessary (bilateral in two of these cases) and one further case (with cavity) was about to commence artificial pneumothorax treatment, while in three cases the changes had at first progressed but were later, temporarily at least, brought into a quiescent state. It is thus obvious that the "initial foci" have quite a serious prognosis. This becomes even more apparent after a follow-up examination carried out this year (i.e., 14 years later). Of the 19 cases three had died from pulmonary tuberculosis. The remaining 16 are alive, completely recovered and fully fit for work, but no less than four of these had required artificial pneumothorax treatment before they could recover.

The development of pulmonary tuberculosis from "initial foci" will be further demonstrated in the following cases.

Case 1: Female, aged 22, was negative to 1 mg. of old tuberculin and x-ray photograph in January 1936 was normal. Four months later she had pyrexia and headache and was strongly tuberculin positive. The erythrocyte sedimentation rate was 21 mm. in one hour. X-ray film (Figure 1) showed enlarged and dense left hilus shadow and pulmonary infiltration basally in the left lung (primary complex). Eight months later initial foci were represented by slight diffuse opacity in the left supraclavicular region. Through the opacity small spots appeared. Similar spots were also present in the second right intercostal space (Figure 2). Tubercle bacilli were demonstrated. The changes progressed later and made sanatorium treatment necessary. Gradual improvement occurred.

Case 2: Female, aged 16, had erythema nodosum and left-sided primary complex in 1935. Control x-ray films in 1935-1940 showed gradual calcification of the primary complex. In October 1940 initial foci were seen in both supraclavicular regions (Figure 3). Sanatorium treatment was instituted. X-ray films in December 1941 showed status quo. In March 1942 there was confluence of the spots in the

FIGURE 6 FIGURE 7 FIGURE 8

Figure 6, Case 3: Initial foci in right supraclavicular region.—*Figure 7, Case 3:* Progression. Now changes in right supraclavicular region and first intercostal space. Cavity the size of a walnut in right supraclavicular region. Sanatorium treatment.—*Figure 8, Case 3:* Right-sided artificial pneumothorax treatment. Improvement.

right supraclavicular region. New spots in the right supraclavicular region and first intercostal space (Figure 4). Tubercle bacilli demonstrated. Sanatorium treatment again. Right-sided artificial pneumothorax was begun. In July 1944 progression was shown in the left supraclavicular region where a cavity the size of a hazel nut was found (Figure 5). Left-sided artificial pneumothorax was instituted. Gradual improvement occurred.

Case 3: Female, aged 20, had changes typical of initial foci demonstrated in October 1941 (Figure 6). The patient was controlled with short intervals between the examinations. At first there was regression then in July 1942 progression. The changes now involved the right supraclavicular region and first intercostal space. In the right supraclavicular region there was a cavity the size of a walnut. Tubercle bacilli were demonstrated (Figure 7). Sanatorium care was accepted. Artificial pneumothorax was given from 1942 to 1946 (Figure 8). There was gradual improvement.

Case 4: Female, aged 25, was examined repeatedly in the Students' Dispensary in Uppsala and was persistently tuberculin negative to 1 mg. of old tuberculin. She did not receive BCG as this was not so common as it now is. Exposed to tuberculous infection in September 1941. On October 1, 1941, normal x-ray picture and still tuberculin negative. The following month she had a positive tuberculin reaction and her lungs were radiologically normal. On March 28, 1942, i.e. seven months after the tuberculous infection, initial foci could be observed in the left supraclavicular region (Figures 9 and 10). X-ray film two months later showed the same appearance. She was summoned for renewed control four months later, but could not be contacted then. Repeated attempts (post, parish register, etc.) to get in touch with her were unsuccessful. It became apparent later, that she had left town and had married. Three years later she was encountered at a mass miniature radiography investigation in Uppsala where she had returned and taken a job. The changes were now appaling (Figure 11). The entire left, and the upper part of the right lung were destroyed. She was placed on sanatorium treatment but died after some months.

SUMMARY

1) "Initial foci" require to begin with, as a rule, no treatment but they must be followed carefully and x-ray photographs must be taken every month or alternate month. If the changes should prove stationary the interval between the control examinations may be increased to four to six months at the most, but they must be followed for many years. Should the individual spots be poorly delimited a progression may be feared earlier, for which reason control examination of such cases must be conducted particularly carefully. Should the spots show a tendency to coalesce or should fresh ones develop after some time, sanatorium treatment is required.

2) Prior to the introduction of chemo-antibiotic treatment only ordinary sanatorium regime could be considered at the beginning. If the progression nevertheless continued, the lesions increased or began to coalesce, artificial pneumothorax was induced with, if necessary, cauterization of adhesions. Artificial pneumothorax treatment was thus employed before the development of cavities. The fact that this was a correct method became obvious since the induction of artificial pneumothorax treatment had been delayed somewhat too long in certain cases at the beginning.

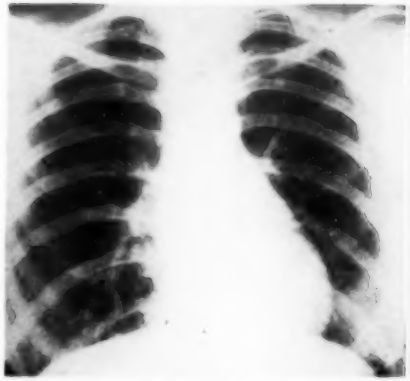

FIGURE 9

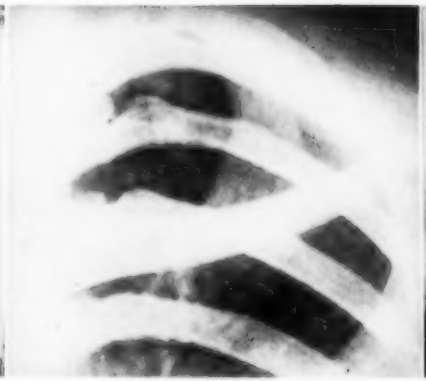

FIGURE 10

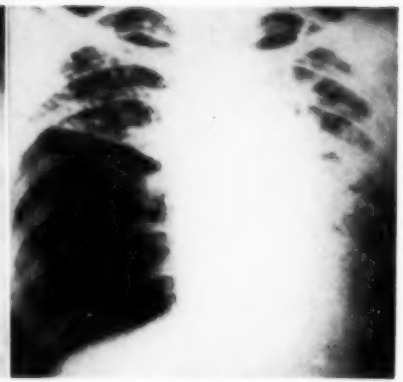

FIGURE 11

Figure 9, Case 4: Initial foci in left supraclavicular region. —— *Figure 10, Case 4:* Regional photograph left apex (cf. Fig. 9 and Fig. 11).—*Figure 11, Case 4:* Condition approximately three years later.

3) Since the introduction of chemo-antibiotic treatment, I have, however, waited somewhat longer before commencing artificial pneumothorax therapy, because these lesions have proved strikingly sensitive to streptomycin. As a rule, good results have been obtained by administering 0.5 gm. streptomycin daily for three months. More recently, in cases of "initial foci" as with other forms of tuberculosis 12 gm. PAS have been employed daily in addition to streptomycin. No extra rapid improvement of the results have been observed since this combined treatment was commenced.

4) Streptomycin, as a rule, with or without supplement of PAS, compels the "initial foci" to regress. The cases must, however, be followed radiologically for a long period. Artificial pneumothorax is induced now only when the spots show a distinct progressive tendency and cause development of infiltration indicating caseation.

5) I have not allowed segmental operation to be carried out on cases of this early type of tuberculosis.

RESUMEN

1) Los "focos iniciales" no requieren en principio, como regla, ningún tratamiento pero deben ser seguidos cuidadosamente y se deben tomar radiografías de torax cada uno o dos meses. Si los aspectos se demuestran estacionarios el intervalo debe aumentarse entre cuatro y seis meses cuando mas, pero deben seguirse por muchos años. Si las lesiones individuales son mal limitadas puede tenerse un progreso mas pronto y por tanto en casos el examen debe ser mas cuidadoso. Si tienen tendencia a la coalescencia o han nuevos focos, se requerirá tratamiento sanatorial.

2) Antes de la introducción de los antibióticos el tratamiento ordinario consistía sólo en el régimen de sanatorio, al principio. Si el progreso continúa, las lesiones aumentan o se conglomeran, el neumotorax se inició y se haría si fuese necesario sección de las adherencias. El neumotorax sería entonces aplicado antes de la aparición de cavidades. El hecho de que esto es correcto se evidenció cuando se comparó con lo que ocurrió cuando la iniciación del neumotorax se retardó en ciertos casos al principio.

3) Desde la introducción de la quimioterapia he esperado algo mas antes de empezar a usar el neumotorax, porque estas lesiones se han mostrado sensibles a la estreptomicina. Como regla se obtuvieron buenos resultados administrando 0.5 gm. de estreptomicina por tres meses. Mas recientemente en casos de "focos iniciales" como en otras formas de tuberculosis se empleó PAS diariamente ademas de la estreptomicina. No se han obtenido cambios mas rápidos desde que se inició este tratamiento combinado.

4) La estreptomicina con o sin PAS obliga al "foco inicial" a la regresión habitualmente. Los casos deben seguirse sin embargo por los rayos X por largo tiempo. El neumotorax artificial es solo iniciado cuando las manchas muestran una tendencia progresiva clara o cuando hay indicios de caseificación.

5) No he permitido que se lleve a cabo resección segmentaria en casos de este tipo temprano de la enfermedad.

RESUME

1) Les infiltrats précoces ne demandent en règle générale au début, aucun traitement mais doivent être suivis avec soin et des radiographies doivent être faites chaque mois ou tous les deux mois. Si l'évolution se montre stationnaire, l'intervalle entre les examens de contrôle peut être élargi de quatre à six mois au plus, mais ils doivent être suivis pendant plusieurs années. Si les lésions isolées ont des limites imprécises, on peut craindre une évolution plus précoce, c'est pourquoi l'examen de contrôle doit dans de tels cas être pratiqué avec un soin particulier. Si les lésions montrent une tendance à la coalescence ou si de nouvelles lésions apparaissent après quelque temps, le traitement sanatorial doit être entrepris.

2) Avant l'introduction de la chimiothérapie et du traitement par les antibiotiques, il ne pouvait être question que de cure sanatoriale. Néanmoins, si l'extension des lésions continuait, si les lésions augmentaient ou commençaient à s'agminer, on était amené à créer un pneumothorax avec si nécessaire section des adhérences. Le traitement par pneumothorax artificiel était ainsi utilisé bien qu'il n'y eût pas encore de cavités. La valeur de cette méthode fut prouvée quand dans certains cas no tardait trop à créer le pneumothorax.

3) Depuis l'introduction du traitement chimiothérapique, l'auteur cependant à attendu un peu plus longtemps avant de commencer le traitement par pneumothorax artificiel, parce que les lésions s'étaient montrées sensibles à la streptomycine de façon frappante. En règle générale, de bons résultats ont été obtenus en administrant 0.50 gramme de streptomycine quotidiennement pendant trois mois. Plus récemment, dans le cas d'infiltrats précoces, de même que dans d'autres formes de tuberculose, le P.A.S. à la dose de 12 grammes par jour a été associé à la streptomycine. Il n'y eu pas d'amélioration particulièrement rapide depuis l'utilisation de ce traitement combiné.

4) En règle générale, la streptomycine, avec ou sans P.A.S. amène la régression des infiltrats précoces. Ces cas doivent être cepandant suivis radiologiquement pendant une longue période. Le pneumothorax artificiel est utilisé maintenant seulement lorsque les taches montrent une tendance nette à la progression et amènent le développement d'infiltrations qui font suspecter leur nature caséeuse.

5) L'auteur ne s'est pas cru autorisé à proposer les résections segmentaires dans ces formes précoces de tuberculose.

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Diagnosis in Congenital Heart Disease*

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In spite of the fact that a large volume of literature on congenital heart disease has appeared during the past several years the field to many physicians, among them some cardiologists, remains somewhat mysterious. This is most unfortunate because every practitioner who might see a child with a congenital cardiac abnormality should be able, through the use of readily available means, to arrive at a reasonably close anatomic diagnosis.

Many things contribute data to be used for identification of a particular lesion: the history, the physical examination, roentgenography, the electrocardiogram. Confirmation of the diagnosis may require contrast study of the heart and great vessels and/or cardiac catheterization. Basic in the use of all these implements is a knowledge of circulatory physiology and an acquaintance, at least, with the embryology of the heart and with some of the possible aberrations in its development.

Congenital cardiac lesions are numerous in type and offer many difficulties in classification. The time-honored grouping of lesions under cyanotic, acyanotic and cyanosis tardive is informative only to a limited degree. More satisfactory is one which expresses not only direction of shunt but also the chamber most affected by the abnormality and the effect on the pulmonary circulation. Such a schema is, of course, more elaborate but is also more helpful in narrowing to a reasonable number the diagnostic possibilities (Table I).

In general, congenital lesions of the heart affect circulatory dynamics in one or more of three ways: by obstructing blood flow from a chamber or vessel, by increasing blood flow to a chamber or vessel or by interfering with oxygen supply to the heart. The end result of each mechanism is an extra work load on one or more chambers.

Flow to a chamber or vessel is increased by shunting of blood from one circulation-pulmonic or systemic- to the other. This occurs as a result of defects in the septa between chambers, the conjoint walls of vessels or through an abnormal connecting vessel such as the ductus arteriosus. Such shunts occur in the majority of congenital cardiac lesions. The direction of flow may be from left-to-right (arterio-venous), right-to-left (venous-arterial), or bidirectional. In the case of intracardiac shunts there is probably in most cases a bidirectional shunt although that in one direction is predominant. The direction of the shunt depends upon the pressure differential between the donor and recipient chamber or vessel. A higher pressure in the left, or arterial side will cause it to be toward the lower pressure right side, and vice versa. The direction of dominance determines

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the presence or absence of one of the most striking signs of these conditions: cyanosis. Cyanosis results from an excess of reduced hemoglobin in the systemic circuit. In the lesions under discussion the arterial unsaturation is due to the admixture of venous and arterial blood via a communication between the two systems, or because the systemic circulation originates from the right heart, as in transposition of the great vessels. Only rarely is it due to other causes. The presence of cyanosis in the patient, therefore, allows us to dismiss certain possibilities until other, more likely, ones have been ruled out.

Certain items in the history of the cyanotic child may be of aid in developing an initial impression as to the nature of his anomaly. When did the cyanosis first appear? If it was present at birth or shortly thereafter, obviously the mechanism for a right to left shunt was present at that time. This introduces the possibility of conditions in which there is obstruction to normal outflow from a right heart chamber plus a septal defect (tricuspid atresia or stenosis plus an atrial communication, pulmonary stenosis plus a ventricular communication), origin of the systemic circuit from the right heart (transposition), or complete mixing of blood

CLASSIFICATION OF CERTAIN CONGENITAL CARDIAC LESIONS

NO SHUNT

EFFECT GENERAL	EFFECT ON RIGHT SIDE	EFFECT ON LEFT SIDE
	Pulmonary Flow Normal	
Dextrocardia	Right coronary from PA	Coarctation of aorta
Idiopathic hypertrophy	Aneurysmal dilatation right coronary	Subaortic stenosis
Heart Block		Bicuspid aortic valve
		Anomalies of aortic arch
		Left coronary from PA
	Pulmonary Flow Decreased	
	Uncomplicated pulmonic stenosis (Idiopathic dilatation of PA)	
	Ebstein's malformation without septal communication	

WITH SHUNT

LEFT-TO-RIGHT	RIGHT-TO-LEFT
Pulmonary Flow Increased	*Pulmonary Flow Decreased*
Left ventricular work increased	*Left Ventricular Work Increased*
Patent ductus arteriosus ——→	Tricuspid atresia
Aortic septal defect ——→	Ebstein's Malformation with patent foramen ovale
	Vena Caval drainage into L.A.
Right ventricular work increased	*Right Ventricular Work Increased*
Atrial septal defect ——→	Tetralogy of Fallot
Aorticoventricular fistula ——→	Pulmonary Stenosis with p.f.o. or atrial septal defect
Ventricular septal defect ——→	Transposition of great vessels
Aortic septal defect ——→	Truncus arteriosus

Arrow indicates possibility of right-to-left shunt developing.

as in absence of septa or a common great vessel to both greater and lesser circulations. Cyanosis developing after several months or years allows consideration of other entities; for example, pulmonary valvular stenosis plus a patent foramen ovale. In this condition there is no right to left shunt and, hence, no cyanosis until the time arrives when the right ventricle can no longer fully compensate for the obstruction to its outflow and there develops a relative tricuspid insufficiency or a condition of incomplete emptying of the right atrium. Right atrial pressure rises sufficiently to force the flap away from the foramen ovale and a right to left shunt ensues. As other examples we may consider three conditions which are ordinarily classed as acyanotic; atrial septal defect, high ventricular septal defect and patent ductus arteriosus. Cyanosis may develop late. These three lessions are characterized initially by increased pulmonary flow, a left to right shunt. The degree of shunt depends upon the size of the communication and the systemic circuit pressure. In many cases as time goes on certain changes develop in the peripheral pulmonary vessels which result in narrowing of their lumina. The cause of the changes is problematic. Certainly the increased flow must be the main factor. The increased oxygen content of the pulmonary blood may play a part. In any event, resistance to pulmonary flow develops and increases and pulmonary hypertension appears. This may progress to the point where, in the case of the patent ductus, pulmonary pressure exceeds aortic. There will then develop a shunt of venous blood into the arterial system and cyanosis will appear. If the patient has a high ventricular septal defect the right ventricular pressure, which also depends upon pulmonary resistance, may rise to equal or exceed that of the left ventricle. A right to left shunt at the ventricular level becomes significant and the patient exhibits cyanosis. The much discussed Eisenmenger's complex is nothing more than this: a high ventricular septal defect complicated by the development of pulmonary vascular changes and pulmonary hypertension. To state, as is often done, that this complex is a tetralogy of Fallot without pulmonary stenosis is to miss the point. We may see the same process, eventually, in atrial septal defect. Right heart pressure, as a result of pulmonary resistance, rises to a point where a right to left shunt at the atrial level is possible, and cyanosis results.

From the physical examination of the cyanotic patient one may sometimes gather very important diagnostic information. First, the degree of cyanosis although it may be significant prognostically is obviously of little constant diagnostic value. The same degree of discoloration may be present in a variety of lesions, depending upon the size of the communication and the presence of compensatory mechanism. Difference in degree of cyanosis in different parts of the body, however, may be very significant. For example, in a condition already mentioned—patent ductus arteriosus with pulmonary vascular changes, pulmonary hypertension and a reversal of the direction of shunt through the ductus-cyanosis may be apparent only in the left arm and the lower extremities; in the left arm because the aortic orifice of the ductus is in a favorable position with respect to the

origin of the left subclavian artery and in the lower extremities because the general position of the ductus favors a direct flow to this area from the pulmonary artery. Similarly, a patient with coarctation of the aorta and a patent ductus distal to the coarctation might exhibit cyanosis of the lower extremities and a normal coloration of the head, arms and trunk. In this case unoxygenated blood from the pulmonary artery would flow with little hindrance through the ductus into the descending aorta, while fully oxygenated blood from the left ventricle would supply the head, arms and the skin of the trunk.

The status of pulmonary flow, another of the criteria in our classification, is determined less readily clinically than the direction of a possible shunt. Careful physical examination of the heart is productive of one important sign and that is the character of the second cardiac sound in the third left interspace. This sound is produced, so far as we know, by closure of the pulmonic valve. Pulmonary stenosis, then, would be marked by absence of this sound. On the other hand, increased flow through the valve and pulmonary artery might be marked by accentuation of this sound. If one can be satisfied that what is heard in the third left interspace is pulmonic and not transmitted aortic, he may come close to substantiating a diagnosis of pulmonary stenosis or of a condition in which there is increased pulmonary blood flow. The most valuable information in this regard, however, comes from x-ray films and fluoroscopic inspection. The caliber of the peripheral pulmonary vessels is the best guide, outside of actual measurement by cardiac catheterization, to the character of pulmonary flow. Abnormally clear lung fields indicate obstruction to right ventricular output, whether due to valvular or infundibular stenosis or atresia of the main pulmonary artery. Increased markings in the periphery bespeak a left to right shunt and increased flow. The size of the main pulmonary artery segment and of the right and left main branches is significant only if tney are diminutive—they then indicate small flow. If they are large this does not necessarily indicate adequate or increased flow. Severe pulmonary valvular stenosis may be accompanied by post-stenotic dilatation of the pulmonary artery and if one were to neglect consideration of the size of the peripheral vessels one might then be misled as to the relative amount of blood coming to the lungs. The cause of this post-stenotic dilatation lends interesting ground for speculation. We have noted at operation in some of the younger patients with pulmonary stenosis that there is a localized systolic bulge of the antero-superior portion of the vessel wall where a jet of blood strikes. In older patients with dilated vessels this bulge is not prominent or is absent although one can palpate the jet. Perhaps, the dilatation can be explained on the basis of axis of flow through the stenotic valve. If the flow is in the main axis of the pulmonary artery it does not result in dilatation of the vessel. However, if the flow is eccentric and the jet strikes the wall, there is at first a systolic bulge; in time the wall is stretched and the vessel dilates.

The third criterion of our classification, heart chamber primarily affected, is also determined by x-ray film and fluoroscopic inspection, as well as by

electrocardiography. The chambers in which we usually are most interested are the ventricles. They bear the stress in the majority of cardiac anomalies. Right ventricular hypertrophy is indicated by rounding and elevation of the apex in the postero-anterior view and by encroachment of the heart shadow on the retrosternal space in the right anterior oblique view. In many patients the chamber may be so large early in life that there results a visible deformity of the anterior chest wall, it being more prominent than the right. The electrocardiogram is significant if it demonstrates the pattern of right ventricular hypertrophy. Enlargement of the left ventricle is more difficult to determine. Encroachment by the left ventricular shadow on the shadow of the spine is usually of relatively little value; the chamber may be merely pushed back by an enlarged right heart. Anterior displacement of the interventricular notch is a valuable sign but so often the notch cannot be seen. Elongation of the left cardiac border in the antero-posterior view with dipping of the apex below the diaphragm shadow is perhaps the best roentgen index of enlargement of this chamber. Electrocardiographic confirmation is most important. Right atrial enlargement we have found difficult of demonstration. We have encountered many patients proved at operation to have a huge right atrium as a result of an atrial septal defect who on x-ray film and fluoroscopy gave no evidence of dilatation of this chamber. The electrocardiogram in some cases will give valuable evidence. Left atrial enlargement, of course, is best demonstrated by a lipiodal esophogram in small children, by barium in older children in whom aspiration is not to be feared.

SUMMARY

Every practitioner who sees a child with a congenital cardiac anomaly should be able to arrive at a fairly close anatomic diagnosis through the use of data derived from the history, the physical examination, fluoroscopy and the electrocardiogram.

A classification of certain congenital cardiac anomalies is given, with a brief discussion of the criteria involved.

RESUMEN

Todo médico práctico que ve un niño con una anomalía cardiaca congénital debe estar capacitado para llegar a un diagnóstico bastante exacto anatómicamente, por los datos derivado de la historia clínica, el exámen físico, la fluoroscopía y el electrocardiograma.

Se presenta una clasificación de ciertas anomalías cardiacas congénitas con una discusión breve del criterio respectivo.

RESUME

Chaque médecin traitant qui voit un enfant atteint d'une affection cardiaque congénitale doit être capable d'arriver à un diagnostic anatomique à peu près exact, grâce aux éléments qu'il peut obtenir des antécédents, de l'examen du malade, de la radioscopie et de l'électro-cardiogramme.

L'auteur propose une classification de certaines anomalies cardiaques congénitales, avec une brève discussion sur les critères utilisés.

Intralobar Pulmonary Sequestration*

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Pulmonary displacement associated with an anomalous artery has been frequently described since the advent of much chest surgery. The earliest adequate report of such a case is generally attributed to Tissler in his Düsseldorf thesis, unpublished but quoted by Müller.[1] Earlier classical descriptions by Rektorzek[2] (1861), and Humphrey[3] (1884) and later Simpson[4] (1908) are quoted by McCotter.[5] These cases reviewed by McCotter were all autopsy cases in children under two years of age. In over 6,000 post-mortems at the Hospital for Sick Children in the past 25 years, there was no case. It would therefore appear a rare pathological finding after death and not a killing disease of the young, albeit it may be a severely crippling one. Extralobar sequestration on the other hand is usually an autopsy diagnosis, and rather likely to remain one.

Forty-two cases of intralobar sequestration have been reported in recent years, up to November 1951 (Cole[6]). Since then Kergin[7] has published the record of five cases and Bruzzoni[8] of one. In this paper six further cases are described. They were all seen at the Sick Children's Hospital, and were diagnosed in part clinically preoperatively and the others by examination of the specimen after excision and by the finding of an aberrant artery when the portion of lung was removed.

The first of these cases diagnosed at the time of operation was in 1948. The resected lung was being discussed at a pathological conference as something of a problem. The surgeon, Dr. F. R. Wilkinson, arrived late, but having read Pryce's[9] paper the night before, was able to distinguish himself as a diagnostician. Some of the cases reported in this paper were seen prior to this time, but diagnosed in retrospect. The surgeon had however, noted the systemic artery when he removed the mass. Pryce[10] had reported the condition earlier but little attention appeared paid to the first paper until the second one was published. Brief mention of two cases was made by Haight[11] in 1941. The term intralobar sequestration has been applied to these cases since Pryce's paper in 1948.

The purpose in reporting the following cases is to add to the list of published cases, and perhaps make some suggestions whereby clinical diagnoses can be made. Awareness of the anomaly and its clinical course make preoperative diagnosis easy. It has been made in all those seen since 1948.

Cases with pulmonary agenesis seen at the hospital have not been included in this paper despite the fact that most observers now consider them to be due to the same embryonic accident produced earlier. Brief mention should be made of three cases in which pneumonectomies were done. We would not subscribe to a theory attributing all kinds and degrees

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of cystic lung to amputated lung buds caused by aberrant arteries. Probably Kirkland's[12] estimate of 5 per cent due to this etiology is right. The three cases alluded to would appear to belong in this minority group. They were in young children. No ordinary infection causing bronchiectasis could be inculpated. The changes involved the whole lung. Large cysts and honeycombed areas of tissue associated with alveolar hypoplasia were found. There was little or no shift of the mediastinum such as would be expected when such general involvement with an acquired case was found. The surgeon noted in each case the lack of disturbance to the child when the lung was removed. No anomalous vessels were found. This does not preclude their having been the teratogenic factor according to Rosenthal.[13] He states that an anomalous artery may cause the severing of the lung bud, and then itself become separated from the aorta. If these cases may be considered as sequestrations, the amputation of the lung bud must have occurred between the 4 mm. and 14 mm. embryo. Bruwer[14] states that the accident at the 4 mm. stage results in agenesis, and at the latter of sequestration of only a portion of lung. The only other teratological explanation of these lungs would be that there was interference with the growth of ducts and alveoli which according to Strukow[15] normally continue to grow up to the seventh year. Müller[16] states such faulty growth may be due to prenatal or postnatal inflammatory changes. This explanation would appear more applicable to those cases of cystic disease developing after birth and not confined to one lung.

Etiology

The production of a dislocated portion of lung with a systemic arterial supply is now considered by most writers to be produced by the amputation of a primitive lung bud by an anomalous vessel. This was pointed out by Cockayne[17] in 1917. Berry[18] demonstrated the same thing in 1941. The theory was supported by Pryce[9,10] Earlier explanation of such distortions of the lung as advanced by Eppinger[19] and others are not acceptable now. They believed them due to an accessory anlage developed from the stomach. The age of the embryo at which the amputation occurs determines the extent of the damage. Thus early separation results in agenesis, or if our conception of the etiology of the pneumonectomy cases alluded to be correct, to extensive involvement of the whole of one lung. Later disruption involves only a portion of lung. Rusby and Sellors[20] consider extralobar sequestration is due to still later disruption. The latter is therefore more likely to be associated with other congenital anomalies.

Pathology

Essentially these displaced masses are characterized by polycystic disease with alveolar hypoplasia. An aberrant artery enters this mass and sometimes supplies part of the adjacent normally developed lung. The cysts may be large blebs or small, giving the lung a honeycomb appearance. The mass may be within a lobe of lung or completely separate from it. The contigious lung may be involved in the infection and show bronchi-

ectasis. Normal bronchi sometimes enter the mass. The bronchi however are usually represented only by blind pouches. Endarteritis is common. This was pointed out by Betts.[21] Such changes might be due to increased pulmonary tension from the systemic blod supply. Bruwer considers them dependent on sepsis and the age of patient. They were not vary marked in our cases.

Fatty changes of some degree are often seen. In one case they were of sufficient magnitude to suggest lipoid pneumonia. The case was similar to the one reported by Clagett et al.[22] These writers attempted to relate the changes to the increased blood supply from the aberrant vessel, but ruled it out. They analyzed the fat and from their results decided the changes were due to endogenous tissue breakdown. In our case, four large vessels entered the mass, but a similar area appeared in another child's lung with no anomalous vessel. It is strange if sepsis is the cause, that the changes are not more commonly seen in bronchiectasis.

Kirklin[12] pointed out that tuberculosis occurs as associated infection in not more than 5 per cent of lung cysts. Bruwer[14] (1950) said no cases of associated sequestration and tuberculosis had been reported. Two cases in this series had tuberculosis. The sequestrated masses were formed by large cysts containing tubercle bacilli but in no wise resembling tuberculous cavities.

One case in this series showed calcareous plaques and cartilaginous tissue. Cartilage without bone was present in one other. Pryce reported similar changes in some of his patients.

The pleura is always thickened and becomes a shaggy surface to the resected specimen.

The abnormal artery most frequently comes from the abdominal aorta, but may arise from the intercostals. It may form a large leash of vessels or be a single large artery 0.5 to 0.7 cm. in diameter. Its systemic nature is indicated by its origin and the nature of its walls. These are thicker and more elastic than vessels of the lesser circulation.

Clinical Findings and Symptoms

Intralobar sequestration may be readily diagnosed clinically if such a possibility is borne in mind. The fact that no case was found at autopsy would suggest that such lesions may be quiescent until later in life, unless discovered by x-ray surveys. Symptoms develop when infection occurs. This may result from hematogenous spread of infection or from severe disease in the adjacent lung. The usual causative infections producing bronchiectasis in children are lacking.

The clinical history is farily uniform. Some cough may be reported as occurring from birth. It is not usually serious and only becomes so when infection of the mass develops. Subsequently general deterioration in health is noted. There are recurrent bouts of fever. Cough is worse. There is usually little or no sputum. Offensive odour to the breath or sputum is infrequent. Severe hemoptysis may occur.

Several findings obtained on physical examination are significant. No

clubbing has been seen in our cases. The mediastinal shift compared to the size of the mass and apparent pulmonary collapse, is slight if any. This fixity is commonly noted at operation. The physical signs are usually greater and more permanent than in ordinary bronchiectasis.

Radiology

The x-ray film demonstrates the true nature of the case. The mass itself is often of considerable density, at times homogenous. Cystic areas are usually visualized in it or in nearby portions of the lung. The mediastinum is mid-line.

The bronchogram usually shows a mass into which no lipiodol penetrates. Occasionally, it may enter for a short distance. The demonstration of a complete bronchial tree, diseased or otherwise, extraneous to the mass, is important. Careful attention to this detail will prevent removal of a mass and leaving behind bronchiectastic portions of lung with the false assumption that disease is all excised.

Treatment and Prognosis

The only effective therapy is surgical removal of the abnormal lung plus any infected normally developed lung. The results are unusually good.

Case Reports

Case 1: A.B. (male) ae. 7, 1930. Child was admitted at age six because of mediastinal tuberculosis. In addition to the hilar lymph nodes, the radiogram showed a large homogenous mass in the right lower chest. The tuberculin test was positive.

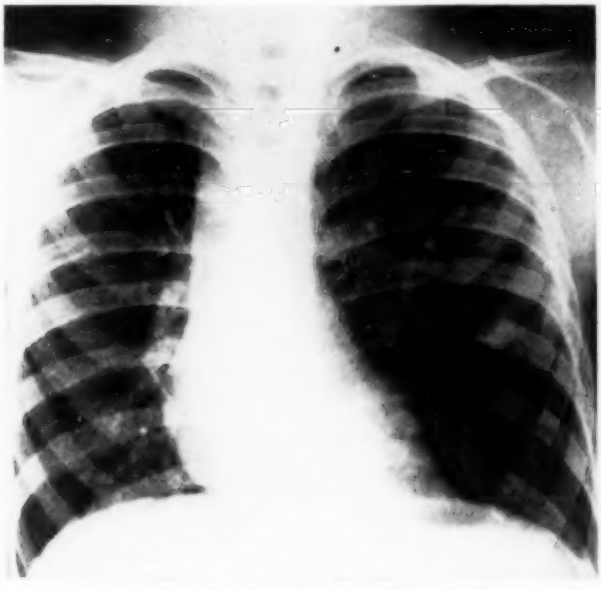

FIGURE 1: A.P. of Chest showing cystic areas.

There was a large tuberculous ulcer in the right main bronchus. Five attempts were made to obtain a good bronchogram of this area without success. Lobectomy was done October 1932 after preliminary phrenicotomy. The mass was separated with great difficulty from the diaphragm and the adjacent pulmonary lobe. An intercostal artery entered that mass.

Specimen: There were many tough pleural adhesions. There was a large cystic cavity in the apex of this specimen. The posterior portion of the specimen showed practically no normal lung tissue. The great bulk of the lobe was filled by a large irregular cavity traversed by numerous partitions. The largest cavity measured 6 x 2 cms. There were many smaller ones. The cavities contained small amounts of pus. Microscopically the whole lung presented a similar picture. There were a few alveoli lined by cuboidal epithelium. There was little or no elastic tissue. Cilia were rare. The degree of destruction was out of all proportion to the fibrosis seen.

Case 2: R.A. (male) ae. 5. Child had not been well for six months when he had an acute attack of bronchitis. Since that time he coughed a great deal, tired easily, and had bouts of high fever. His tuberculin test was positive as was also his sputum.

Right pneumonectomy was supposedly done in 1940 but eight years later his upper and middle lobes were found undisturbed at a subsequent operation.

At operation dense adhesions bound the lung to the chest wall and diaphragm. It was necessary to remove a portion of the latter to free the lung. There were also many adhesions between the mediastinum and the edge of the lung. In one of these was a fair sized blood vessel which came through the diaphragm from the aorta.

Specimen: The surface was ragged. There was a cavity 6 x 5 cm. in the lower portion. The medial portion of this extended toward the mediastinal border in a sort of bay 3 cm. long filled with yellow caseous material. No dilated bronchi were found. There was a large thrombosed vascular channel 6 mm. in diameter filled

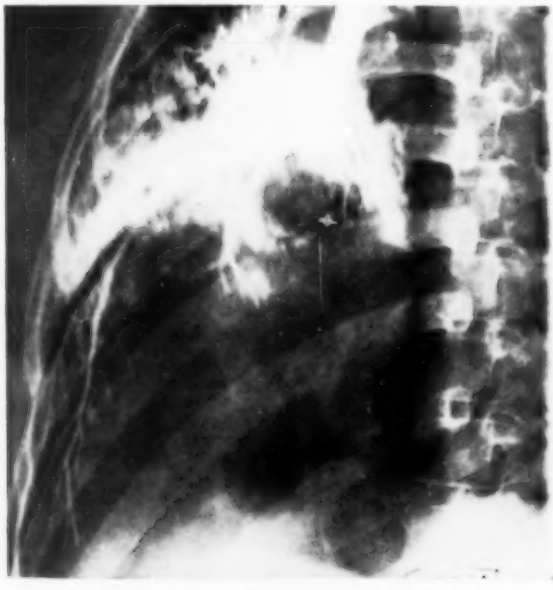

FIGURE 2: A.P. and lateral bronchogram.

with thrombus. There was a large fibrosed vessel on the base. There were elastic fibers in its wall.

Case 3: N.G. (female) ae. 4. 1939. This child was in hospital in infancy with pneumonia. She was well after this until a few months before admission, when she complained of weight loss, lassitude, and later anorexia and cough. Subsequently she had frequent bouts of fever. The x-ray film presented is typical of the disease showing the left lower mass. Many attempts were made to fill this with lipiodol without success.

Left lower lobectomy was done in 1948. The lobe appeared grossly diseased. There was no air containing lung except at the upper part. The remainder of the lobe was firm on palpation. There were many adhesions in mediastinal and diaphragmatic areas. There was a large leash of vessels coming from the aorta four inches below the arch to the postero lateral aspect of the lobe about one and one half inches from the diaphragmatic surface. Three of these were as large as the radial artery.

FIGURE 3: Specimen of sequestrated mass. Note emphysematous blebs. Large artery entering the mass. Cut sections of mass.

Specimen: The lobe was or normal size. A consolidating process involved the whole of the postero-lateral portion. There were fibrous adhesions. The remainder of the lung was deep bluish color while the affected part was pale greyish yellow. Four large arteries entered the posterior aspect of lobe 2 cm. from the diaphragmatic surface. These arose directly from the aorta and broke into ramifications through the parenchyma (See celloidin injected lung picture). Water forced through with considerable pressure entered the pulmonary artery. The vessels appeared to be large bronchial arteries with a large anastomosis with the pulmonary arteries. The posterior basic and the middle half of the adjacent middle basic appeared to be the only parts involved. The posterior basic division was constricted about 2 cm. from the hilum. From this point on the bronchial divisions appeared as greatly dilated cystic spaces and fibrous tissue. They were between 1 and 1.5 cm. in diameter. Yellow granules were imbedded in both the spaces and the fibrous tissue. They were filled with pus.

Microscopically all the bronchi and bronchioles were dilated cystic spaces filled with pus. Most were lined with columnar epithelium but some small spaces showed cuboidal epithelium. The cysts were separated by oedematous fibrous tissue with extensive lymphocytic infiltration, and great vascularity. There were some phago-

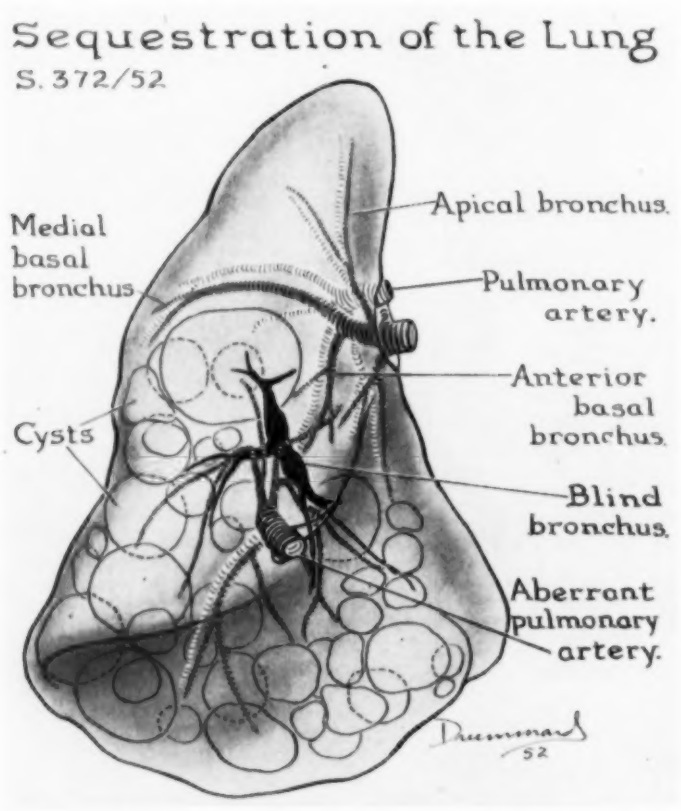

FIGURE 4: Artist's drawing of lung showing systemic vessel and blind bronchus.

cytes containing fatty material. The blood vessels were large and thick walled and had organized well developed elastic tissue. There was little elastic tissue in the walls of the bronchi. The remainder of the specimen showed the usual type of bronchiectasis and did not communicate with this portion.

Case 4: A.S. (female) ae. 13, 1940. This child had acrodynia at three years of age with cough ever since. One year ago she had pneumonia, since then cough has been much worse and of late has been accompanied by hemoptysis. Physical signs were all in the left chest. In this same area, there was a rounded mass behind the heart. It was impossible to fill this area with lipiodol but above it, the bronchogram showed definite bronchiectasis. Left lower lobectomy was done supposedly but later x-ray films showed the bronchiectasis still present and only the rounded shadow removed. At 18 this diseased area was removed at hospital for adults. Death followed two days later.

The first operation showed dense pleural adhesions. There was much haemorrhage from a vessel of fair size in the vicinity of the pulmonary ligament. Its origin was not determined. The lung was removed by excising proximally to a noose.

The specimen consisted of an irregular portion of lung. There were no normal landmarks. The pleural surface was shaggy and haemorrhagic. Palpation showed irregular consolidated areas. The cut surface showed large vessels and bronchi. The intervening lung tissue was fibrotic and consolidated. The bronchi as shown in the bronchogram were not found.

Sections showed general bronchial dilatation. The bronchi were lined with stratified columnar epithelium and were greatly thickened. The thickening was for the most part due to increased lymphoid tissue and infiltration with chronic inflammatory cells. The muscle coats were gone. There were a few islands of cartilage. There were also spicula of bone in one fibrotic area. Many alveoli were hypoplastic and lined with cuboidal epithelium.

Case 5: J.L. (female) ae. 9½ yrs., 1949. This child has never been really well, but worse since pneumonia at two years. She has had persistent cough without much sputum since. During this period she had five bouts of fever, 103 to 105 degrees F., and pneumonia again nine months ago. There has been general deterioration in health since that time.

Operation: The whole left pleural cavity was obliterated by adhesions. These were more marked along the main fissure between the upper and lower lobe. On palpation, the lower lobe was firm and rubbery, with slight crepitations. At the base of the lung, on the lateral portion, there was a large artery coming from below the diaphragm but it was impossible to determine its origin.

The specimen showed an enlarged and firm lower lobe and lingula. The aberrant artery entered 3 cm. from the posterior tip. The cut surface showed numerous cavities filled with pus.

Microscopically all the bronchi and bronchiolae were dilated and their walls infiltrated with inflammatory cells. The muscle tissue, glands, and elastic tissue were replaced by fibrous tissue. The abnormal vessel was a systemic artery.

Case 6: B.N. (male) ae. 6, 1952. Child was well until five years of age he had pneumonia, following which his general health deteriorated. He had many bouts of fever. Cough developed, without sputum and became progressively worse. Both his radiograph and bronchogram showed the changes characteristic of cystic fibrosis. Lobectomy was done in 1952.

At operation many cysts were seen over the left lower lobe. There was a large artery in the pulmonary ligament running from the aorta below the diaphragm.

Pathology: The left lower lobe measured 14-9 x 3 cm. The dorsal segment was the only portion that inflated well. The large cysts over the base could not be filled by inflation. On the cut surface the dorsal segment appeared normal. The

posterior basic segment was composed of many multiloculated, thin wall cysts containing clear fluid but no air. There was no communication between these cysts. There was some alveolar tissue between them. The anterior and middle segments were compressed to about 1.5 cm. in thickness. The dorsal bronchus was normal. The middle and anterior bronchi were displaced superiorly and fanned out over the cystic regions. The bronchus to the posterior basal segment was defective, being represented only by a few short bronchioles descending just under the pleura on the mediastinal surface.

The pulmonary artery measured 0.3 cm. in diameter while the aberrant vessel was 0.7 cm. across. It entered the lung at its posterior surface about 1 cm. above the inferior border at the end of the pulmonary ligament. It penetrated the lung about 0.8 cm. and broke into four branches which arborized into all of the cystic portion (see drawing). At the bifurcation, there was a small linear area, yellow and slightly thickened. Two of the branches accompanied a bronchus that did not communicate with the exterior. The vessels were large for only 2 cm. before they arborized. The isolated bronchus was probably a sequestrated posterior basal bronchus. It was about 0.4 cm. wide. It branched into bronchioles when the artery divided. Some of the branches entered into small centrally placed cysts by small atria but never connected with any normal airway.

Microscopic examination showed the walls of the cysts to be composed of columnar ciliated epithelium lying on a smooth muscle wall. In places there was continuity between the cysts and normal alveoli and ducts. The wall of the blind bronchus was composed of ciliated columnar epithelium, smooth muscle, cartilage, collagen, glands, vessels and nerves. The intervening parenchyma appeared normal. The walls of the main bronchi were heavily infiltrated with chronic inflammatory cells. The cyst walls showed little inflammation.

The walls of the aberrant artery were composed of alternating layers of elastic tissue and smooth muscle fibre. There were approximately 14 wide elastic lamina as well as numerous finer elastic fibres.

SUMMARY

1) Six further cases of a congenital lung anomaly of both teratological and clinical interest are described.

2) The anomaly consists of a portion of displaced lung tissue in the chest cavity with hypoplastic alveoli and dilated bronchi which give the lung its honeycombed or cystic appearance. This displaced lung is the recipient of a systemic vascular supply usually from the aorta. It has come to be called intralobar sequestration since Pryce's paper was published.

3) It is probably due to the amputation of a primordial lung bud by an aberrant artery, occurring in the 4 to 14 mm. embryo.

4) The history, physical findings, and radiographic changes which make its diagnosis easy, are discussed. The clinical importance of its correct diagnosis is indicated.

5) Three cases are mentioned in which the whole lung was involved in the process and the question raised if such a result could not ensue rather than agenesis when earlier more massive portions of the bronchial tree are amputated.

RESUMEN

1) Se describen seis casos mas de una anomalía congénita pulmonar de interés tanto clínico como teratológico.

2) La anomalía consiste en una porción de tejido pulmonar desplazada

en la cavidad torácica con alveolos hipoplasicos y bronquios dilatados que dieron al pulmón apariencia de panal o cística. Este pulmón displástico tenia un sistema vascular emergiendo generalmente de la aorta. Se ha llamado secuestración intralobar desde que se publicó el trabajo de Pryce.

3) Probablemente se debe a la amputación de una llema primitiva del pulmón por una arteria aberrante ocurriendo en el embrion de 4 a 14 mm.

4) La historia, los hallazgos fisicos y los cambios radiográficos que hacen facil su diagnóstico, se discuten. La importancia clinica de su correcto diagnóstico se indica.

5) Se mencionan tres casos en los que todo el pulmón estaba comprometido por el proceso y suscitaron el problema de si tal resultado podrian ocurrir mas que la agenesia cuando mas tempranamente porciones mas voluminaosas del arbol bronquial son amputadas.

RESUME

1) L'auteur décrit six cas d'anomalie congénitale du poumon, qui présentent un intérêt clinique et tératologique.

2) L'anomalie consiste en une portion de tissu pulmonaire déplacé dans la cavité thoracique avec alvéoles hypoplastiques et bronches dilatées, qui donne au poumon un aspect kystique ou en "rayon de miel." Ce poumon anormal reçoit un système vasculaire de suppléance, provenant généralement de l'aorte. Il est passé dans les habitudes de l'appeler "séquestration intralobaire" depuis la publication de l'article de Pryce.

3) L'anomalie est due probablement à la séparation d'un bourgeon primitif par une artère aberrante, survenant chez l'ambryon de 4 à 14 mm.

4) L'auteur discute l'histoire du malade, les éléments de l'examen physique et des altérations radiologiques qui en facilitent le diagnostic, et mentionne l'importance clinique d'un diagnostic correct.

5) L'auteur rapporte trois cas dans lesquels la totalité du poumon était intéressée par ce processus. Il pose la question de savoir si un tel résultat ne pourrait pas être plutôt en cause que l'agénésie lorsque des portions plus importantes de l'arbe bronchique sont amputées.

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Complications of Enzymatic Debridement in Pulmonary Tuberculosis with Bronchopleural Fistula

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The use of trypsin to digest the exudate of tuberculous and nontuberculous empyema has been reported by Roettig, Reiser, Habeeb and Mark[1] as an effective means of preparing the patient for re-expansion of the lung, decortication, or pneumonectomy. On occasion, empyema has been sterilized of tubercle bacilli by this method. Our experience with enzymatic debridement in tuberculous patients with bronchopleural fistula and empyema has been unfortunate. Three cases are reported in which serious complications occurred as a direct result of this treatment. The effects of enzymatic therapy in six other cases will be summarized. Trypsin was employed in all cases. The combination of streptokinase and streptodornase with trypsin was used in a few of the treatments in three cases.

Report of Cases

Case 1: This 46 year old white woman had minimal tuberculosis of the right upper lobe in 1939. In 1944 cavitary disease of the left upper lobe developed, and with conservative treatment was considered arrested in October, 1947. Reactivation of this lesion occurred in December, 1950, and segmental resection of the left upper lobe was performed on June 6, 1951. One month later the bronchial stump opened and empyema resulted. The empyema was aspirated and 1 gm. of streptomycin with 100,000 units of penicillin was instilled every two weeks for five months. She was admitted to this hospital on December 31, 1951, when her physical condition appeared good, she was well nourished, and weighed 131 pounds. The heart was normal in size, and no murmur or friction rub was heard (Figure 1). On January 7, 1952, 250 mg. of trypsin in 20 cc. of phosphate buffer was instilled into the empyema space and aspirated five hours later. Shortly after repeating this procedure on the next day, her temperature rose to 104 degrees F. and she became dyspneic. On January 9, the third trypsin instillation was given. For the next three days she was nauseated and feverish. On January 12, 200,000 units of streptokinase and 300,000 units of streptodornase were added to the trypsin; this treatment was followed by nausea and a fever of 102 degrees F. The empyema fluid had become watery and slightly opalescent; her general condition, however, had deteriorated markedly. Her fifth and last trypsin treatment was given on January 15, eight days after the first treatment. Following this she had less fever, but developed a severe laryngotracheobronchitis. An x-ray film taken on January 17 revealed marked enlargement of the heart shadow and fresh opacities in the right lung (Figure 2). The next day cardiac failure and severe pulmonary edema developed. She was digitalized, and placed on intermittent positive pressure oxygen therapy with the Bennett valve. On January 19 a pericardial tap was performed, with the removal of 300 cc. of serosanguineous fluid. She was given chloromycetin (500 mg. every 48 hours) and penicillin (200,000 units every three hours). She also received

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18 gm. of streptomycin between January 9 and 29. Her condition gradually deteriorated, and she died on January 29, 1952.

Autopsy: The body was well developed and fairly well nourished, measuring 64 inches long and weighing 120 pounds. The chest was symmetrical and bore a healed thoracotomy scar. An empyema space occupied the major portion of the left hemithorax. The upper lobe of the left lung was absent, except for the lingula, which with the lower lobe was collapsed against the mediastinum and posterior parietal chest wall. The stump of the bronchus of the upper lobe appeared completely stenotic, but microscopically several small bronchial branches communicated with the empyema cavity. The wall of the empyema cavity was fibrous, smooth, dark red to gray, and about 4 mm. thick. Only a few shreds of purulent material and no free fluid were present. The left lung weighed 175 gm. The parenchyma was soft, collapsed, and gray. The apex of the lower lobe was fibrotic. The right pleural space was bridged by a patch of dense fibrous apical adhesions. The right lung weighed 740 gm. the apical and posterior segments were severely shrunken and fibrosed, with a few minute yellow nodules. The middle lobe equaled the lower lobe in size, due to the presence of many pale yellow, airless, lobular areas of consolidation. A similar extensive pneumonic process involved the posterior half of the lower lobe. The pericardial sac contained about 100 cc. of liquid and clotted blood, and the entire epicardium was coated by a layer of yellow shaggy fibrinous exudate which measured 1 cm. thick. The heart weighed 406 gm. and showed no intrinsic lesions. Microscopic examination confirmed the presence of an early extensive necrotizing tuberculous pneumonia of the right lung and acute tuberculous pericarditis. The epicardium was overlaid with a thick zone of epithelioid cells, which showed a few foci of necrosis, rare giant cells, and no fibroblastic proliferation. Where the pericardial sac was in contact with the wall of the empyema, the fibrous tissue exhibited foci of caseous necrosis. Elsewhere the empyema wall was composed of dense fibrous tissue with a thin superficial zone of necrotic tissue, small hemorrhages, and a few mononuclear cells and lymphocytes.

Case 2: This 30 year old white man who had a tuberculous cavity in the left lower lobe underwent lobectomy on December 19, 1951. The tubercle bacilli were

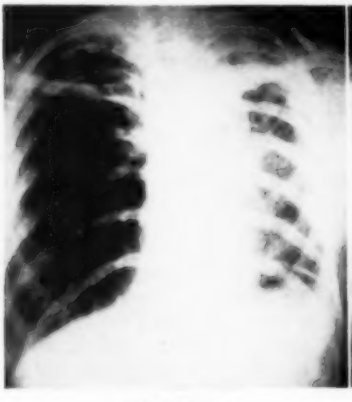

FIGURE 1

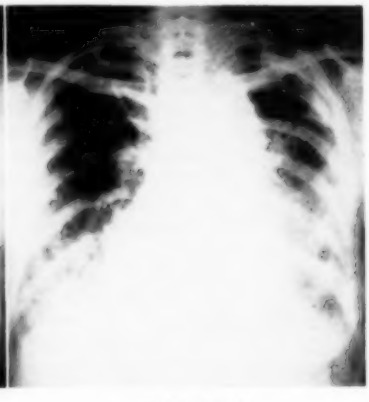

FIGURE 2

Figure 1, Case 1: Empyema occupying left upper chest. Before enzymatic therapy.
Figure 2, Case 1: Pneumonic tuberculous spread in right lung field. Marked enlargement of heart shadow; tuberculous pericarditis. Ten days after first trypsin treatment.

resistant to streptomycin and paraaminosalicylic acid. One month postoperatively the bronchial stump opened, and empyema, which contained hemorrhagic purulent fluid, formed above the left diaphragm (Figure 3). Four instillations of trypsin in 250 mg. doses were administered between January 26 and February 12, 1952: In the second and third instillations, 100,000 units of streptokinase and 25,000 units of streptodornase were added to the trypsin. During the third trypsin instillation on February 9, 1952, he coughed violently, and the empyema contents were aspirated as evidenced by the expectoration of material identical in color and consistency with that of the empyema cavity. His temperature immediately rose to 103 degrees F. He raised frothy hemorrhagic sputum for the next two days. On February 12, the last trypsin treatment was given, and was closely followed by the expectoration of bloody fluid. An x-ray film on February 15 showed spread of disease in both lung fields (Figure 4). Treatment with aldinamide and iso-nicotinic acid hydrazide resulted in subsidence of his cough, fever, and anorexia. The x-ray film showed evidence of regression of the fresh spread. A weight loss of 25 pounds had occurred since the onset of the empyema, but at the present time he is regaining weight.

Case 3: This 34 year old white woman with bilateral cavitary pulmonary tuberculosis of the upper lobes was treated with cavernostomy on the left side. A necrotic chest wound, 6 cm. in diameter, persisted. This open cavity was filled with 250 mg. of trypsin in 20 cc. of phosphate buffer on two successive days. The same dosage of trypsin as powder was then insufflated daily for the next six days. The cavity wall rapidly became clean, and it was lined with healthy granulation tissue with white fibrous tissue showing through. Shortly after the start of therapy, she developed a temperature of 101 to 103 degrees F. and had marked fatigue and anorexia. After the seventh treatment, she suddenly developed a paroxysmal cough and acute laryngotracheobronchitis. For four days she coughed up increasing amounts of bloody sputum. Extensive areas of increased radio-opacity developed in both upper lobes and in the right lower lobe in one week. Her weight fell from 100 to 86 pounds within six weeks. She also developed peripheral polyneuritis. Four months later, after special feeding and massive vitamin therapy, she began slowly to improve.

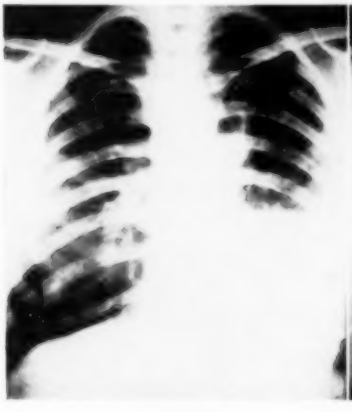

FIGURE 3

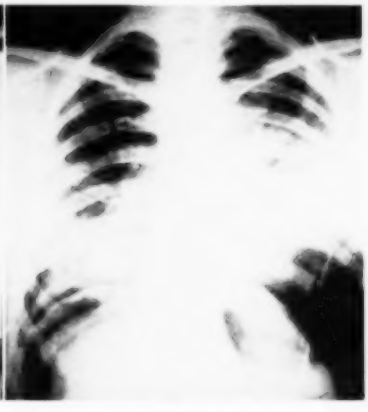

FIGURE 4

Figure 3, Case 2: Empyema in left lower chest, one month after lobectomy and before trypsin therapy.—*Figure 4, Case 2:* Tuberculous spread in both lung fields, three weeks after first trypsin treatment.

TABLE I

CASE	DIAGNOSIS	TREATMENT	RESULTS	COMPLICATIONS
4. White male Age 27	Previously unroofed empyema; bronchopleural fistula.	7 daily trypsin irrigations.	Wound became clean and epithelialized rapidly.	Mild laryngotracheobronchitis.
5. White male Age 52	Previously unroofed empyema; bronchopleural fistula; thoracoplasty.	3 daily trypsin insufflations.	No improvement; treatment stopped due to intolerance of skin.	Massive hemorrhages 6 weeks later requiring ligation of pulmonary artery.
6. White male Age 39	Postpneumonectomy empyema; bronchopleural fistula; large chest wall defects; thoracoplasty.	Closure of bronchial and cutaneous fistulas. Trypsin irrigations, 14 in 17 days pre-op. and 24 in 4 months post-op.	Empyema wall clean at thoracotomy. Closure of chest wall defects and bronchus successful. Residual pleurocutaneous sinus.	
7. White female Age 37	Postpneumonectomy empyema; bronchopleurocutaneous fistula.	12 trypsin irrigations in 14 days. Thoracoplasty, pleurectomy, and closure of fistulas.	Empyema successfully debrided. Death 84 hours postoperative. Bronchopneumonia and nodular tuberculosis of lung.	
8. White male Age 29	Empyema following pneumothorax; bronchopleural fistula.	Thoracoplasty. Trypsin irrigations, 11 in 21 days pre-op. and 7 in 2 months post-op.	Purulent drainage converted to thin and slightly opalescent fluid.	Postoperative atelectasis and bronchitis in opposite lower lobe.
9. White male Age 41	Empyema following pneumothorax; bronchopleural fistula.	Pleuro-pneumonectomy. Trypsin irrigations, 10 in 3 months pre-op. and 9 in 6 weeks post-op. (One with streptokinase and streptodornase).	Empyema wall clean and space nearly obliterated. Pleurocutaneous fistula developed postoperatively.	

Discussion

Enzymatic therapy was employed to clean the wall of the empyema or open tuberculous cavity and to convert the thick exudate to a thin serous fluid. The result in each of the three cases was, as anticipated, successful locally. The performance of further surgical procedures, including closure of the bronchial fistulas, was contemplated. However, the enzyme and lysed exudate had gained access to the tracheobronchial tree and was aspirated into other portions of the lungs. X-ray evidence of fresh pneumonic tuberculosis was observed shortly afterwards. In case 1, the tuberculous nature of the extensive acute pulmonary lesions was verified at autopsy. The tuberculous pericarditis was probably the result of direct extension into the pericardial sac. In case 2, aspiration of the enzymes and digestion products of the infected fluid was actually observed during the third treatment. The patient was suddenly seized with paroxysmal coughing, and expectorated fluid which was identical with that of the empyema cavity. In case 3, the patient developed a cough and laryngotracheobronchitis following the seventh treatment. One week later tuberculous pneumonic spread, or the reactivation of pre-existing lesions, in both lungs was demonstrated by x-ray film.

The explanation that the spread of tuberculosis was caused by aspiration of infected fluid appeared most probable. Patent bronchial fistulas were present in each case. Paroxysmal coughing occurred during one treatment in two cases, and was closely followed by the production of increased amounts of hemorrhagic sputum. The cough reflex was apparently absent in the other patient. The increase of fever, malaise, and anorexia, and x-ray evidence of spread of disease showed a close temporal relationship to the therapy.

After the instillation of trypsin, a temporary febrile reaction which is easily controlled by antihistaminics and salicylates is frequently produced. In each of these three cases, however, the febrile reaction was profound, prolonged, and unrelieved by antihistaminics or salicylates. The fever was at first thought to be the result of systemic absorption of break-down products from the digestion of the purulent exudate, and therefore therapy was not discontinued. The extension of disease was suspected nevertheless, and confirmed by x-ray films.

The results of enzymatic debridement in the six other cases of tuberculosis in the series are summarized in Table I. The dosage of trypsin in each treatment was 250 mg. In none of the six was aspiration of the empyema fluid observed, although each patient had a bronchopleural fistula. In five of these cases, debridement of the empyema was considered to be successful. The persistence of a small subscapular pleurocutaneous sinus was not regarded as a failure in case 6, as large defects of the chest wall were present pre-operatively. In case 8 thoracoplasty was done following trypsin therapy, and was to be followed by pleuro-pneumonectomy. The patient, however, developed bronchitis and atelectasis in the contralateral lung, and the pleuro-pneumonectomy was postponed. Pleuro-pneumonectomy

with successful closure of the bronchus was performed in case 9, after trypsin treatment, but a pleurocutaneous fistula developed post-operatively. The only complications which possibly could be attributed to trypsin were mild laryngotracheobronchitis in case 4, and hemorrhages from an exposed pulmonary arterial branch, occurring several weeks after the last treatment in case 5. The role of the trypsin in the fatal outcome of case 7 was difficult to assess, but the enzymatic treatment was not believed to be responsible for the contralateral pulmonary tuberculosis.

Streptokinase and streptodornase were added to the trypsin to increase the digestive action of the solution. Streptodornase, unlike trypsin, hydrolyzes desoxyribose nucleic acid, and its inclusion in particular was thought desirable in promoting the efficiency of debridement. Streptokinase is inactivated by trypsin and was probably of no value. Miller, Long, and Stafford[2] have reported the successful use of these two agents as adjuncts in the treatment of tuberculous abscesses. They also treated two cases of tuberculous empyema with bronchopleural fistula without experiencing complications. They advocated caution, however, in employing enzymatic therapy in tuberculosis when bronchopleural fistulas are present because of the danger of aspiration. In our series of cases, these enzymes were used so infrequently that no conclusion can be drawn regarding their importance in the resulting complications.

SUMMARY

The results of the treatment of eight cases of tuberculous empyema with bronchopleural fistula and of one case of open cavernostomy by enzymatic debridement are reported. Trypsin was used almost exclusively. In eight cases the tuberculous exudate diminished and was converted to a thin fluid. Disseminated acute pulmonary tuberculosis developed in three patients as the result of aspiration of infected fluid through bronchial fistulae. One of these cases, which terminated fatally, also exhibited tuberculous pericarditis as a complication. The presence of a bronchial fistula is a hazard in the enzymatic treatment of tuberculous empyema.

RESUMEN

Se relatan los resultados de el tratamiento de ocho casos de empiema tuberculoso con fistula broncopleural y de un caso de cavernostomía abierta por desbridación enzimática. Se uso tripsina casi exclusivamente. En ocho casos la exudación tuberculosa disminuyó y fué convertida en un delgado liquido. Tuberculosis pulmonar aguda diseminada se desarrolló en tres pacientes debido a la aspiración de fluido infectado a través de fistulas bronquiales. Uno de estos casos que concluyó fatalmente también presentó pericarditis tuberculosa a modo de complicación. La presencia de una fistula bronquial es un obstáculo en el tratamiento enzimático del empiema tuberculoso.

RESUME

Les auteurs rapportent les résultats du traitement de huit cas de pleurésie purulente tuberculeuse, avec fistule bronchopleurale, et d'un cas de

cavernostomie ouverte. Ils ont utilisé l'action détergente d'origine enzymatique. Is se sont servi d'une façon générale à peu près exclusivement de trypsine. Dans huit cas, l'épanchement tuberculeux diminua et se transforma en un liquide fluide. L'aspiration du liquide purulent à travers la fistule bronchique détermina chez trois malades une tuberculose pulmonaire aigue disséminée. Un de ces cas, dont l'évolution fut fatale, se compliqua en outre de péricardite tuberculeuse. L'existence d'une fistule bronchique comporte un danger certain dans le traitement enzymatique de la pleurésie purulente tuberculeuse.

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Cavitation Within Bland Pulmonary Infarcts*

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The differential diagnosis to be considered in pulmonary lesions showing evidence of cavitation in the roentgenogram becomes increasingly difficult as we attempt to differentiate between inflammatory and neoplastic processes. One generally associates evidence of cavitation within the lung with abscess formation and evacuation; however, rapidly growing pulmonary metastases, especially those of sarcomatous origin, may also show cavitation of the central portion due to ischemic necrosis. When the question arose as to whether pulmonary infarcts due to bland emboli ever underwent aseptic necrosis with cavitation, the opinions voiced by members of the consulting staff of the hospital differed so widely that we were moved to review the experience of the Minneapolis Veterans Administration Hospital in regard to cavitation within bland pulmonary infarcts over the three-year period, 1948 to 1951.

Prior to the use of antibiotic therapy, metastatic abscesses due to septic emboli from a distant site of phlebitis were not uncommon. In contradistinction to those septic emboli we now see bland emboli arising more commonly from sites of phlebothrombosis in the veins of the pelvis or lower extremities in patients who exhibit no other signs of any infectious process. The pathology of septic thrombophlebitis as distinct from the more common aseptic phlebothrombosis has been most thoroughly described by Ochsner.[1] He has pointed out that thrombosis within an infected vein is marked by bacterial invasion of the wall of the involved vessel. The thrombus in such a vessel is firmly attached to the wall and becomes thoroughly infected as well as highly organized. As this infected thrombus breaks down through a process of necrosis, the resulting emboli are really no more than bits of necrotic debris. When phlebothrombosis occurs in the pelvic veins or deep veins of the lower extremities as a result of a slowing of the circulation or an alteration of the clotting mechanism in certain individuals, the thrombus is sterile and is only loosely attached to the vessel wall. The difference in size and character of the emboli arising from the two differently involved areas accounts for the different effect that the emboli have on the lung. The small bits of necrotic debris rarely cause massive infarction but do cause metastatic abscesses while the big bland thrombi which may escape into the circulation from deep beds where they silently form may block the cardiac valvular orifices or cause massive pulmonary infarction.

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Embolization of the lung must be differentiated from pulmonary infarction, for bland emboli to the lung may cause no demonstrable changes whatever in the lung or the roentgenogram if the bronchiolar circulation is capable of utilizing the capillary anastomosis between it and the pulmonary artery circulation.[2] Westermark,[3] Shapiro and Rigler,[4] and others agree that the process of embolization causes infarction only when the bronchiolar circulation is also impaired, either by the process of embolization or by arteriolar disease. They have presented cases to show that embolization without infarction does occur and is characterized by an area of hyperradiability due to vascular obliteration distal to the embolus with vascular congestion proximal to it.

From the writings of Ochsner and others we have attempted in Figure 1 to diagram the natural history of pulmonary infarction. Once the process of infarction has occurred, any of the three paths of resolution may follow. Whether or not the infarcted area heals directly depends almost wholly on the volume of tissue involved. Infarcts less than 2 cm. in diameter generally go on to healing directly through a process of resorption unless the infectious element is not controlled by antibiotic therapy and abscess formation ensues. Larger septic emboli and bland emboli which happen to become infected will tend to follow the course at the left of the diagram. If the necrotic process is contained within the lung parenchyma, a typical lung abscess develops. However, infarcts tend to extend to the surface of the lung, and if the process of necrosis extends beyond the visceral pleura, empyema of the thorax must follow. A bloody pleural effusion characterizes most infarcts; thus the empyema is usually a pyohemothorax. If the necrotic process were to proceed in a centripetal manner and erode a bronchus, then a broncho-pleural fistula would develop and a pyohemopneumothorax would exist. These complications of pulmonary infarction

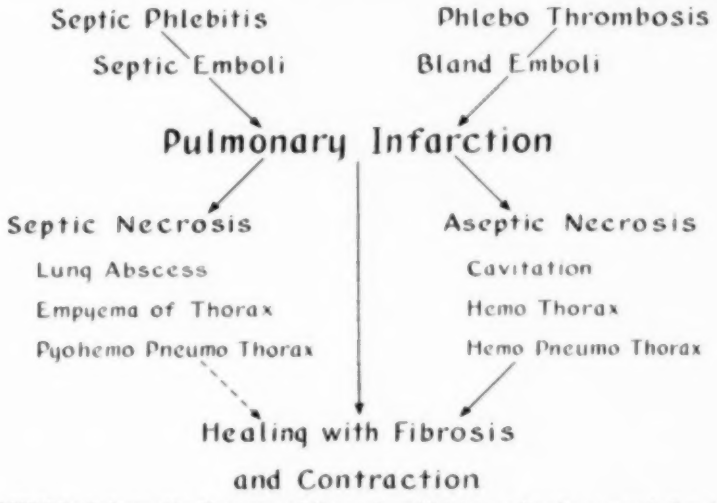

FIGURE 1: Schematic diagram of the natural history of pulmonary infarction.

usually require surgical drainage and often excision before healing can take place.

Infarcts due to bland emboli that do not heal directly nor become infected must eventually follow the path at the right side of the diagram. The aseptic necrosis is usually a process of liquefaction or sloughing. There is one case reported in which necrosis and slough without abscess formation went on to the point of sequestration of virtually an entire lower lobe.[5] Cavitation within an area of liquefaction necrosis is conceivable if the area of necrosis communicates with a bronchus. The development of pneumothorax again depends solely upon whether the process of necrosis extends through to the pleural space.

Two excellent pathological studies of pulmonary infarction have confirmed the belief that infarcts caused by bland emboli frequently do become infected in the course of their otherwise aseptic degeneration. A Mayo Clinic report[6] covering 550 pulmonary infarcts discovered in the course of 6,000 autopsies revealed the presence of 23 frank abscesses in patients who showed no signs of infection elsewhere in the body. Only about 40 per cent of the infarcts were diagnosed before death, and only three of the 23 abscesses were recognized during life. Krause[7] in an earlier series showed an almost identical incidence when he found 17 abscesses in 334 pulmonary infarcts. These necrotic infarcts have the same distribution within the various lobes of the lungs, most often the lower lobes, as do the other non-necrotic infarcts, probably indicating that they all have the same origin and course until such time as infection supervenes.

The manner in which bland infarcts become infected has long been a matter of concern and a number of possibilities have been proposed. Micro-

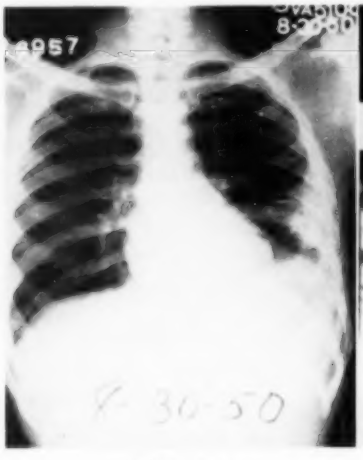

FIGURE 2

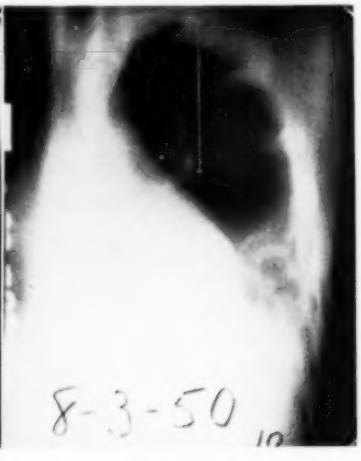

FIGURE 3

Figure 2: Conventional chest roentgenogram in Case 1 showing residual nodule after clearing of pleural effusion.—*Figure 3:* Planigram of involved left lower lobe in Case 1 showing radiolucent area suggesting cavitation within a nodular density.

scopic section through areas of infarction will frequently show the presence of bacteria not only within the area of infarction but within the normal lung tissue outside of the infarct. This observation, together with the fact that organisms can usually be cultured from bits of normal lung tissue, makes it apparent that pulmonary infarcts may become infected by organisms normally residing in otherwise healthy lung tissue.

It has also been observed that organisms from the upper respiratory tract are prone to disseminate downward,[8] leading to pulmonary abscess whenever the cough reflex is lost. In deep surgical anesthesia, during the coma that follows epileptic seizure, or following periods of unconsciousness in alcoholic debauches, pulmonary abscess is a relatively frequent complication. Such abscesses are much more common in persons who have extensive oral sepsis, and when persons with such oral infections are treated prophylactically with antibiotics before surgery, the incidence of postoperative lung abscesses is greatly diminished.[9] This observation has been used to support the belief that pulmonary infarcts become infected from aspirated material that comes down from the upper respiratory tract.

A third mode of infection has been demonstrated by Holman and Mathes[10] who have shown that the area of infarction is particularly vulnerable to the effects of circulating organisms. They were able consistently to produce pulmonary abscesses in experimentally produced infarcts by producing suppurative wounds in experimental animals after infarction had occurred.

The incidence of septic necrosis within the infarct is also related to the size of the infarcted area. When the area of lung involved exceeds 2 cm. in diameter, septic necrosis almost invariably follows.[6] This may be due to the fact that this large volume of avascular tissue must frequently encompass a small bronchiole which may contain infected material.

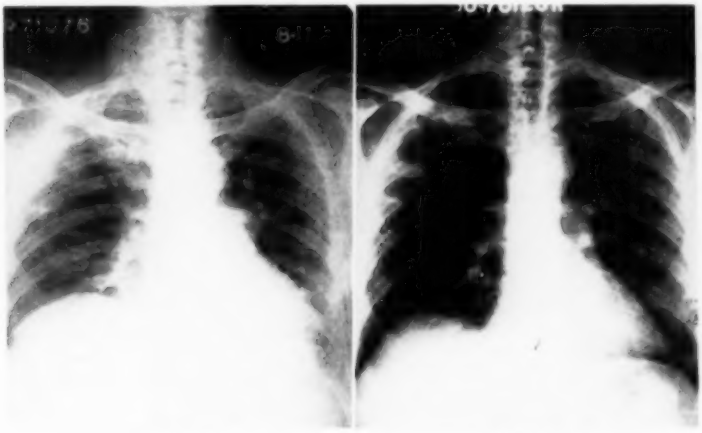

FIGURE 4 FIGURE 5

Figure 4: Conventional chest roentgenogram in Case 2 showing density in right apex.—*Figure 5:* Over-exposed roentgenogram of chest in Case 2 demonstrating large cavity above third rib on right side.

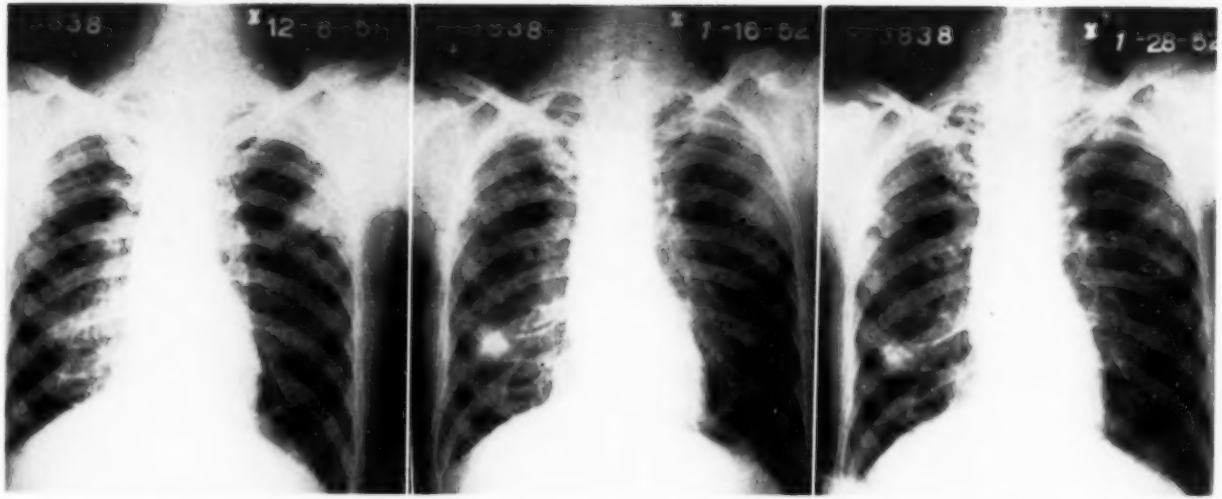

FIGURE 6A FIGURE 6B FIGURE 6C

Figure 6: Serial roentgenograms in Case 3 illustrating the development of apparent cavitation within areas of density caused by multiple infarcts.

Radiologic evidence of cavitation within non-infected infarcts due to bland emboli has apparently been noted but infrequently. Of the 550 infarcts in the Mayo Clinic series which contained 23 abscesses, only one instance of cavitation was demontsrated. In 120 cases of pulmonary infarction studied by Short[11] there was again only one instance of cavitation. In reviewing 99 cases of pulmonary infarction occurring in the Minneapolis Veterans Hospital during the period 1948 through 1951 we found four instances in which a radiologic diagnosis of cavitation was reported. During that time a similar case was encountered in a private hospital and was added to this series. None of the cases presented findings suggesting lung abscess. In each instance the reporting of cavitation by the roentgenologist caused considerable concern on the part of those attempting to arrive at a clinical diagnosis. With only two reported instances of cavitation within the hundreds of pulmonary infarcts reported in various studies, it was apparent that either our roentgenologic criteria for diagnosing cavitation in the lung was wrong, or else cavitation within the pulmonary infarcts was becoming increasingly common.

The following cases are presented to show examples of pulmonary infarction that appeared to cavitate.

Case 1: A 26-year-oid Negro, a professional ball player, was admitted to the hospital complaining of chest pain and cough productive of bloody sputum. Physical examination showed the man to be in acute distress with temperature of 98 degrees F., pulse of 100, and shallow respirations at a rate of 30 per minute. The chest showed dullness below the tip of the left scapula with a friction rub over the same area. There was marked splinting of the chest on the same side, and the affected diaphragm was elevated. Blood hemoglobin was 16.8 gm. per cent; there were 7,900 white cells per cu.mm. with a normal differential count.

A presumptive diagnosis of pulmonary infarction was made and anticoagulant therapy was instituted. On the sixth day 235 cc. of brown fluid was removed from the left chest. This contained 37,900 white cells per cu.mm., 87 per cent neutrophils. A week later a similar amount of fluid was aspirated. Numerous cultures failed to demonstrate the presence of pathological organisms. The only fever observed was a temperature rise to 103 degrees F. following the application of a Mantoux test.

A month after admission consultation was requested because of the persistence of the pulmonary consolidation (Figure 2). Serial roentgenograms of the chest had shown the development of pleural effusion overlying a discrete nodule about 5 cm. in diameter lying within the central portion of the left lower lobe. Planigrams of this area (Figure 3) suggested cavitation within the mass. It was felt that the mass represented a tuberculous cavity or a congenital cyst filled with fluid, and because of the pleural thickening combined excision of the mass and pleural decortication was advised.

Pathological examination of the specimen removed at operation two months after admission indicated that it was an infarct surrounding a large vessel which seemed to contain an embolus. No cavitation was noted. The patient made an uneventful recovery and left the hospital 11 weeks after admission. No evidence of phlebothrombosis was ever demonstrated in upper or lower extremities.

Case 2: A 58-year-old farmer was admitted to the hospital complaining of the sudden onset of chest pain the previous day. Physical examination showed the man to be in no apparent distress despite the presence of an inspiratory lag on the right side associated with a loud pleural friction rub. The left leg was swollen,

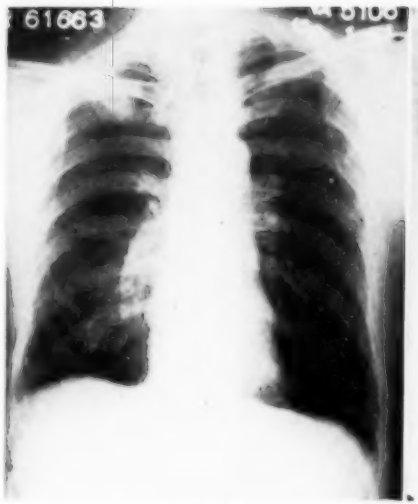

FIGURE 7

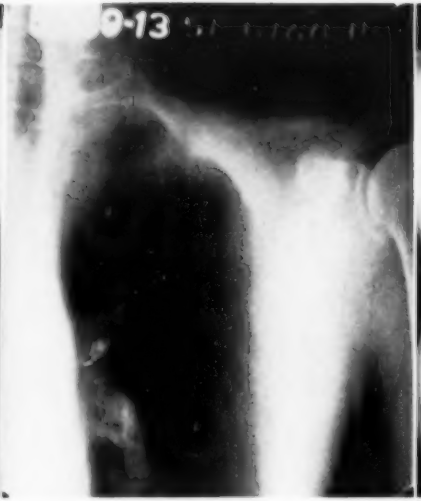

FIGURE 8

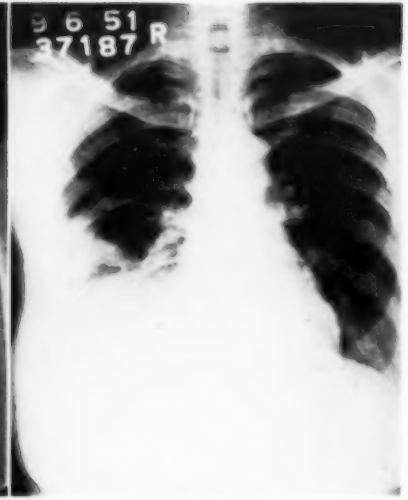

FIGURE 9

Figure 7: Admission roentgenogram in Case 4.—*Figure 8:* Planigram of right apex (in obverse) of Case 4 suggesting cavitation within previously noted density.—*Figure 9:* Planigram of right lower lobe in Case 5 showing peculiar distribution of pleural fluid and a more lateral nodule that seemed to contain cavity.

and there was calf tenderness. The white cell count was 14,600 cells per cu. mm. The chest roentgenogram (Figure 4) showed an area of density about 4 cm. in diameter in the right apex. He had been admitted a year previously with approximately the same findings.

Because of the past history, a vena caval ligation was performed shortly after admission. Therapeutic doses of penicillin and aureomycin were administered throughout the hospital stay. Phlebothrombosis of the right leg developed after the ligation, and serial studies of the right apical lesion demonstrated conclusive evidence of cavitation with the development of a fluid level within the lesion (Figure 5). Because the patient remained virtually asymptomatic, no treatment was directed toward the pulmonary lesion. At the time of discharge from the hospital eight weeks after admission no evidence of the cavitated lesion persisted.

Case 3: A 58-year-old man was admitted to the hospital complaining of severe chest pain and hemoptysis of a few days duration. The right leg had been swollen for nearly two months. He had been treated elsewhere a year previously for concurrent pneumonia and phlebothrombosis. A right femoral and saphenous ligation was done, and following the operation there was recurrence of swelling of the left leg and of hemoptysis. A coarse pleural friction rub was heard on the right side, the temperature rose to 100 degrees F., and the white cell count to 11,650 cells per cu. mm. Serial roentgenogram of the chest (Figure 6) showed the development of soft nodular densities on the side of the pain in each instance. Each of the major lesions also developed an area of radio-luscence within its center suggesting cavitation. The chest lesions caused no apparent symptoms, and by the time of discharge from the hospital six weeks later only small nodular areas of density remained at the sites of the previously suspected cavities. In this case repeated pulmonary embolization presented the opportunity to observe the development and remission of apparent cavitation within areas of infarction.

Case 4: A 64-year-old man was admitted to the hospital for the third time because of recurrent phlebothrombosis complicating chronic stasis dermatitis of the right leg. Physical examination at the time of admission showed the patient to be afebrile and in no great distress. There was marked atrophy of both legs, which were also affected by chronic stasis dermatitis. Roentgenogram of the chest (Figure 7) showed the residuals of an old pleural effusion on the right and some calcified nodes on the same side. An area of consolidation involving the medial portion of the upper lobe and extending from the hilum to the apex was followed by frequent films. He remained afebrile and there was no unusual elevation of the white cell count. Small areas of apparent cavitation were thought to be developing within the area of density (Figure 8), and because of the history of previous pleural effusion the diagnosis of reinfection tuberculosis was strongly considered. Cultures of gastric washings repeatedly failed to demonstrate the presence of tubercle bacilli. While the lesion in the right chest was being observed, another density appeared in the left lung. By this time it was obvious that the man was suffering repeated embolization of the lung and a vena caval ligation was performed. The pulmonary lesions gradually resolved during the convalescence following the surgical procedure. Only his poor physical condition prevented the performance of a thoracotomy for biopsy when the unilateral right-sided lesion was discovered. Until the appearance of the lesion on the left it was thought unlikely that an infarct could undergo such changes, including cavitation, and that some neoplasm was undoubtedly present.

Case 5: A 44-year-old white female department store clerk was admitted to a community hospital complaining of chest pain that awakened her suddenly during the night. She experienced chills and fever, and thoracentesis demonstrated the presence of a grossly bloody pleural effusion. Neoplastic cells were not demonstrated in the fluid, but she was thought to be suffering from pneumonia com-

plicating carcinoma of the lung. She was transferred to another hospital for definitive care, and physical and roentgenologic examination showed the presence of consolidation plus fluid at the right base. Planigrams indicated the presence of an area of consolidation within the apex of the right lower lobe (Figure 9). Pleural effusion was also present, and there appeared to be cavitation within the area of density. At the beginning of the fourth week of illness thoracotomy was seriously considered because the cavitated nodule did not seem to be changing. At the same time the patient complained of pain in the leg and extensive phlebothrombosis was found to have developed in the right leg. She gave the additional past history of recurrent swelling of the legs whenever she sat for more than an hour at a time. Anticoagulant therapy was instituted immediately, and the phlebothrombosis was controlled. Consideration of the presence of pulmonary neoplasm was abandoned, and she made an uneventful and complete recovery.

Discussion

From our own observations and those mentioned in the literature it appears that cavitation may occur within a pulmonary infarct without frank abscess formation being present. From a clinical point of view this is not a clearly defined entity, and it would undoubtedly be more correct to speak of the type and extent of infection within a necrotic infarct rather than attempting to distinguish the really sterile lesions from full-blown abscesses. No degenerating lesion within a lung can long remain sterile while exposed to outside air and bronchial secretions, but there are many degrees of infection between the slightly infected infarct and the putrid lung abscess.

The roentgenological and physical signs of pulmonary infarctions seem to be quite adequate. Nowhere in the literature was any mention made of false positive diagnoses of pulmonary infarction. There was confirmation of the general impression that less than half of the pulmonary infarcts found at autopsy were ever suspected prior to death. This is probably due to either of two reasons: the infarct was a terminal accident and there was no opportunity for signs to develop, or the infarct was so small as to cause too few signs to be recognized. The diagnosis of pulmonary infarction is virtually a certainty when there is a sudden onset of chest pain associated with friction rub, bloody sputum, and bloody pleural effusion of small degree. If there is elevation of the diaphragm on the affected side and a characteristically cloudy or wedge-shaped shadow along with evidence of pleural effusion on the chest roentgenogram the diagnosis is even more secure. The reason that more infarcts do not show the characteristic shadows described by Short is primarily because it is not practicable to obtain various projection views of the lungs at sufficiently frequent intervals to detect the often evanescent shadows caused by infarction. Short is of the opinion that all pulmonary infarcts would show the characteristic wedge-shaped shadow if the roentgenologist were fortunate enough to secure the proper view of the chest at the time that the density of the lesion was sufficient to be seen. Experimentally, at least, not all bland plugs settling out in the pulmonary arterial bed are capable of causing detectable infarcts, so it may be that some infarcts will always escape detection.

Whenever in our experience an attempt has been made to correlate the

x-ray diagnosis of pulmonary cavitation with actual evidence of cavitation in the resected or autoptic specimen, we have been impressed with the high frequency of both false positive and false negative diagnoses. Our presumptive evidence for the presence of cavitation is the typical "hole with a ring around it," but this picture may be caused by any lesion that exhibits a halo or spherical zone of reaction around its center. Infarcts particularly may show the picture of concentric spheres of reaction, the central zone of ischemia being surrounded by a zone of hyperemia, edema, and normal lung. Only the presence of an air-fluid level within such a lesion is certain proof of cavitation.

What is most significant, however, is the high degree of importance that we attach to a diagnosis of cavitation. In treating pulmonary tuberculosis, knowing of the presence of cavitation is important in making some prognostications because the cavitation is usually associated with bronchial disease and is so often accompanied by the production of large volumes of bacilliferous sputum whose organisms tend to develop drug resistance. In treating pyogenic lung abscess before the advent of antibiotics cavity formation was of grave significance because it indicated destruction of tissue. Actually, cavitation was not of any significance itself but heralded the onset of other more grave complications such as advancing lung destruction or pleural involvement that would demand some form of surgical intervention. At the present time it is still the complications and not the cavitation that is important; however, we now are in a position to treat most pulmonary infections so effectively that surgical complications seldom rather than inevitably follow cavitation. In none of the cases showing presumptive evidence of cavitation in the cases that we observed, and in none of the cases mentioned in the literature was there enough extension either within the lung or beyond the pleural surface to require any treatment. Except for those cases that were incidental findings at autopsy, all the infarcts showing presumptive or positive signs of cavitation went on to healing.

Conclusion

Pulmonary infarcts due to bland emboli may go on to aseptic necrosis with cavity formation. This phenomenon is unusual but is significant only in that it should be recognized as one of the sequelae of pulmonary infarction. Antibiotic therapy apparently controls infection sufficiently so that these necrotic infarcts may heal without surgical treatment.

SUMMARY

1) One hundred cases of pulmonary infarction were reviewed and it was found that five had been diagnosed by the roentgenologist as showing evidence of pulmonary cavitation.

2) It was established that cavitation within a pulmonary infarct might occur in the absence of pyogenic abscess formation.

3) Mere presence of pulmonary cavitation did not seem to be a grave prognostic sign.

4) The diagnosis of pulmonary infarction could be made much more frequently by relying on the recognized clinical and roentgenological signs of the condition.

RESUMEN

1) Se revisan cien casos de infarto pulmonar porque se encontró que cinco de ellos habian sido diagnósticados por el roentgenólogo como mostrando evidencia de excavación pulmonar.

2) Se estableció que la excavación dentro de un infarto pulmonar podria ocurrir en ausencia de formación de absceso piógeno.

3) La sola presencia de una excavación pulmonar no pareció ser un signo de pronóstico grave.

4) El diagnóstico del infarto pulmonar podria hacerse con mucho mayor frecuencia si se confiase en los signos clínicos y roentgenológicos reconocidos de esta afección.

RESUME

1) Les auteurs ont passé en revue 100 observations d'infarctus pulmonaires. Ils ont montré que dans cinq cas ceux-ci se présentaient radiologiquement sous forme de caverne pulmonaire.

2) Ils apportent la démonstration que l'excavation d'un infarctus pulmonaire peut survenir en l'absence de tout abcès d'origine infectieuse.

3) La seule présence d'une caverne pulmonaire ne peut être un élément grave de pronostic.

4) Le diagnostic d'infarctus pulmonaire pourrait être fait plus fréquemment en se basant sur les signes cliniques et radiologiques qui appartiennent à cette affection.

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Phthisiogenetic Considerations Based on Tomographic Analysis of 320 Consecutive Cases of Localized Pulmonary Tuberculosis in Adults*

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"The discussion on morphological phthisiogenesis, involved as it may appear, is probably less complex than the facts themselves. At present, it is not possible to present more than possibilities and probabilities in phthisiogenesis and as substratum, some scant facts of morphology" (Max Pinner).

A critical analysis of morphological phthisiogenesis has to be based on direct observations. The knowledge achieved from necropsies and experiments on animals is most conclusive. Continuous observations on patients have been gaining in significance since the improved x-ray technique granted more exact analysis of initial pathological changes. The introduction of tomography marks significant progress in this direction. The systematic combination of antero-posterior and lateral tomography allows a deeper insight into morphological details and at the same time presents new genetic and therapeutic problems. It enables the anatomical localization of specific changes according to the broncho-pulmonary segments and the recognition of pathological findings in the bronchial tree and particularly in its peripheral branches. Besides it yields a more accurate structural analysis of specific foci. We have used this method on a large scale and we can hardly imagine clinical work without it.

It is the purpose of this report to present a roentgen-anatomic (tomographic) analysis of 320 consecutive cases of localized open pulmonary tuberculosis in adults and to evaluate in this way some phthisiogenetic aspects. The cases were examined in our hospital and in our associated institute Beth-Levinstein in Ramataim during the period from January 1950 until April 1952.

Methods and Materials: All cases were examined tomographically according to the methods lately described by us. As a routine each hemithorax was examined separately. A-P tomograms were performed at least in the layers 4 to 11 cm. measured from the back (sometimes from 2 to 15 cm.) and lateral tomograms usually from 4 to 12 cm. measured from the lateral chest wall of the affected side. In unclear findings more planes in half centimeter distance have been added in the suspected fields. Occasionally were also "segmental tomograms" (in the longitudinal axis of the segmental bronchus) and oblique tomograms taken. As far as technique is concerned, attention was paid to pictures soft and rich in contrast and to a longer focus-film distance according to Bronkhorst (140 cm.).

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In this study the occurrence of calcifications is also recorded. These are usually much clearer presented in laminography than in normal routine x-ray films. Most calcifications are so clearly recognized in the tomogram thanks to their dense shadow and irregular shape that no discussion is needed. In the hilus area some doubts may arise in the case of branches of the pulmonary artery seen in perpendicular projection. The comparison of anterior-posterior tomogram with the lateral one and the shape and location of the calcific shadow help to clear up these doubts and in some way the routine film also helps. The case was recorded as negative when no decision could be made.

Into our series were accepted only cases with localized open pulmonary tuberculosis so that diagnostic doubts may be excluded. Cases with far advanced dissemination were rejected in this study as unsuitable for phthisiogenetic considerations.

The ages of our patients ranging from 15 to 60 years had the following distribution:

	Males	Females	Total
15 - 20 years of age	17	25	42
21 - 30 years of age	75	61	136
31 - 40 years of age	55	34	89
41 - 50 years of age	27	17	44
Over 50 years of age	7	2	9
TOTAL	181	139	320

First a mapping of the pathological changes by tomography was performed according to the involvement of the broncho-pulmonary segments. Our tomographic localization of segments proved to be fairly reliable and it was often verified by our chest surgeon Dr. Pauzner, when performing segmentectomies. Difficulties and possibly discrepancies may occur in atypical cases as result of shrinkage and dislocation. The tomographic interpretation may also be unclear or wrong in lesions placed on the border of two segments. All the same the method is sufficiently reliable for clinical purposes and less inconvenient than bronchography.

Evaluating pathological changes we distinguish between *dominant* and *secondary* lesions. This distinction, though including some subjective moment is necessary in order to ascertain the presumable source of further spreads in the lungs. When secondary dissemination is missing any further consideration is needless. Otherwise the clinical picture and the previous x-ray series usually provide a base for this distinction which naturally is not based on anatomical analysis considering the genetic development. Fifteen cases of bilateral tuberculosis located in the apex were also included in this study; in these cases each side was separately recorded as dominant lesion. Thus the number of dominant lesions exceeds the number of examined cases.

Results: Table I shows the distribution of dominant and secondary lesions

according to the involvement of the single broncho-pulmonary segments. It appears that among the 335 dominant lesions 178 were located on the right side and 157 on the left side. Thus we see a slight preponderance of the right side, a fact which agrees with all the previous experience and possibly correspondes to the larger volume of this lung. The number of secondarily affected segments however is larger on the left side. There are 208 segments secondarily affected on the left side and 177 in the right. This difference, although statistically not significant, seems to point to a more pronounced tendency to secondary dissemination in the left lung than in the right.

When we are considering the involvement of the single broncho-pulmonary segments the following picture emerges: the first place is taken by the apical subsegment of the left upper lobe, to be followed by the apical segment on the right side and further by the right posterior segment and the left posterior subsegment. The anterior segments of the upper lobes are quite seldom dominantly affected but they are often the seat of secondary spreads. The same relation holds good for both middle lobe and lingula segments too. In the lower lobes the first place belongs to the apical lower lobe segments on both sides as seat of dominant mostly cavitary lesions. In our study this segment was nearly equally affected on both sides, together in 10 per cent of all analyzed cases. Sweany found in 1931 among 268 cases of "primary reinfection cavities" that 13.7 per cent were located in the apex of the lower lobe. Our percentage is somewhat smaller. On the other hand we may note a more frequent involvement of this segment by secondary spreads. Among the basal lower lobe segments the

TABLE I

Distribution of the Dominant and Secondary Lesions According to the Involved Broncho-pulmonary Segments in 320 Cases of Localized Pulmonary Tuberculosis (15 Bilateral Cases).

	RIGHT LUNG		LEFT LUNG		BOTH LUNGS	
	Dominant	Secondary	Dominant	Secondary	Dominant	Secondary
1. Apical segment	74	(25)	77	(39)	151	(64)
2. Posterior segment	70	(52)	55	(36)	125	(88)
3. Anterior segment	8	(45)	5	(39)	13	(84)
4. Middle lobe lateral seg., Lingula sup.	1	(7)	0	(25)	1	(32)
5. Middle lobe medial seg., Lingula inf.	2	(10)	0	(6)	2	(16)
6. Apical lower lobe seg.	14	(15)	18	(32)	32	(47)
7. Medial basal segment	0	(2)	—	—	0	(2)
8. Anterior basal segment	0	(3)	0	(3)	0	(6)
9. Lateral basal segment	2	(6)	1	(5)	3	(11)
10. Posterior basal segment	7	(12)	1	(23)	8	(35)
TOTAL	178	(177)	157	(208)	335	(385)

posterior one is the most significant particularly as the seat of secondary disease especially on the left side. That is easily understood because this bronchus, previously called bronchus terminalis, is placed as continuation of the lower lobe bronchus running downward, backward and slightly laterally.

If we are considering both lungs together then the apical segments take first place (45.1 per cent of all dominant lesions), the posterior segments second (37.3 per cent) and apical lower lobe segments the third place (10 per cent). Both upper lobes together were involved by dominant lesions in 86.3 per cent. Thus our observations are proving again the old experience that the upper lobes and particularly their apical and posterior parts represent the most frequent situation of pulmonary tuberculosis in adults. Medlar found the location of tuberculous cavities investigated at necropsies in unexpected death in 87 per cent in the upper lobes.

If we take together all segments whose bronchi run in dorsal or dorsal-oblique direction from the hilus (apical, posterior, apical lower lobe and posterior basal segment) then 94.3 per cent of all noted dominant lesions show the dorsal location. This fact corroborates R. C. Brocks thesis on the importance of bronchial embolism and posture, confirmed also by Rabinowitz and Harper by bronchographic examinations in pulmonary tuberculosis.

The distribution of the dominant tuberculous lesions in the various parts of the lungs is evidently different from the location we usually see in real primary tuberculous infection. The distribution of primary tuberculosis according to the affected lobes is known from the classical pathologo-anatomical studies of Ghon and his pupils and from the excellent clinical investigations of Simon Frostad in Norway. Among Frostad's 188 cases of incipient tuberculosis 37 were situated in the right upper lobe, the same number in the left upper lobe, three in the middle lobe, 25 in the right lower lobe and 20 in the left lower lobe. The anatomical situation could not be stated exactly in 20 cases on the right side and in 22 on the left side. In 24 cases there was bilateral incidence of primary foci. Kourilski, Bidermann and Ettedgui recently published a study on 71 cases of primary pulmonary tuberculosis based on radiotomographic and bronchoscopic investigations. The age of the investigated cases ranged from three to 25 years. Twenty-four cases presented only changes in the regional lymph nodes while 47 showed radiologically visible pathology in lung parenchyma. As far as the bronchopulmonary segments are concerned the authors found the following distribution: Right: apical segment three, posterior none, anterior two, axillary two, total upper lobe one, middle lobe lateral three, medial two, total middle lobe six, apical lower lobe none, basal anterior five; Left: apical two, posterior one, anterior four, total upper lobe one, lingula superior one, inferior four, apical lower lobe none, basal anterior one, total lower lobe one; bilateral location two. Thus they found a prevalence of the right side and of the segments situated anteriorly.

This difference in distribution between our dominant lesions and the real primary tuberculosis points to a different genesis and proves that in

the majority of our cases we are not dealing with further local extension of the original primary focus but with a new focus in the course of progression of the disease, what has been previously, not quite exactly, called "reinfection type" of pulmonary tuberculosis.

A useful way to estimate the age of a tuberculous infection in the lungs is the proof of calcifications. Their significance has been much discussed by pathologists and clinicians. The time in which caseous changes calcify varies in different statements from several months to three to five years. One fact, however, seems to be established throughout all pathological and clinical experience: the incidence of calcifications in the center of fresh exudative changes proves that a specific infection had already taken place in previous years, generally in childhood. The size of the calcifications corresponds to the size of the previous caseous changes. Large calcified primary complexes point to a more extended primary or glandular focus. Of greater significance for morphological phthisiogenesis are those calcifications which are spread out in the lung fields particularly in the upper parts, frequently amid caseous-pneumonic conditions with signs of destruction. Their importance and frequent incidence in apparently healthy persons was emphasized by Medlar in his investigations at necropsies in cases of unexpected usually sudden deaths. The results of our study are presented in Tables II and III.

Discussion

The purpose of this study is to contribute to the genesis of pulmonary tuberculosis of adults on the basis of two facts which may be objectively recorded on patients: the anatomical location of localized bacillary processes and the incidence of calcifications.

1) *The distribution of the localized, clinically manifest specific changes according to the broncho-pulmonary segments shows that the great majority of them is situated in the upper and dorsal portions of the lungs.* All cases had been carefully controlled by means of mostly repeated tomography in the antero-posterior and lateral view. The morphological changes were classified as dominant on the basis of the clinical picture and of the

TABLE II

Incidence of Calcifications in 253 Cases of Localized Pulmonary Tuberculosis.

		NO CALCIFICATIONS		CALCIFICATIONS			
				Total		In the involved area	
Age	Total Cases	No.	Per cent	No.	Per cent	No.	Per cent
15 - 20	36	20	55.6	16	44.4	14	38.9
21 - 30	104	43	41.4	61	58.6	44	42.3
31 - 40	69	22	31.9	47	68.1	37	53.6
41 - 50	39	13	33.3	26	66.7	22	56.4
Over 50	5	2	—	3	—	2	—
TOTAL	253	100	39.5	153	60.5	119	47.0

previous course of the disease; further spreads were recorded as secondary disseminations. As far as these secondary lesions are concerned our statistics do not show any preference toward certain segments. The left lung however seems to be more inclined to be affected by secondary disseminations. A probable explanation may be to suppose that the curved course of the left main bronchus renders the drainage towards the bifurcation more difficult and thus facilitates the bronchial embolism on the same side by posture, as long as bilateral spread is not supported by cough or by other ways.

We did not investigate whether the dominant lesions originated on the same place as the primary focus was situated. Such studies could be made only by continuous observation of tuberculin conversion in each single case as it was done by Simon Frostad and Tobias Gedde-Dahl in Norway and by other authors. The typical situation of our localized lesions in the dorsal segments however proves that we are dealing with pathological changes arising from other genetically older foci, most likely by bronchial dissemination. This is apparently true for the "subprimary initial foci" of Malmros and Hedvall and the "early infiltrations" of Assmann: according to our present roentgen-anatomical knowledge these early foci are mostly situated in the posterior segment, sometimes in the apical lower lobe—or in the apical segment.

TABLE III

Location of Calcifications Demonstrated by Tomography in 153 Cases of Localized Open Pulmonary Tuberculosis in Adults.

		THE CALCIFICATIONS LOCATED IN					
		the diseased hemithorax		the involved area		the contralateral hemithorax	
Age	Total Cases	No.	Per cent	No.	Per cent	No.	Per cent
15 - 20	16	14	87.5	14	87.5	2	12.5
21 - 30	61	55	90.2	44	72.1	6	9.8
31 - 40	47	44	93.6	37	78.7	3	6.4
41 - 50	26	25	96.1	22	84.6	1	3.8
Over 50	3	3	—	2	—	0	—
TOTAL	153	141	92.2	119	77.8	12	7.8

TABLE IV

Incidence of Bronchial Dissemination in 194 Cases of Localized Pulmonary Tuberculosis Analyzed by Antero-Posterior and Lateral Tomography.

	The Dominant Lesion was Situated		
	on the right side	on the left side	Total
Homolateral dissemination	52	60	112
Contralateral dissemination	16	7	23
Bilateral dissemination	30	29	59
TOTAL	98	96	194

Furthermore it is a noteworthy fact that the bronchial dissemination in the initial stage of pulmonary tuberculosis generally remains limited to the involved side.

Table IV demonstrates a marked tendency of localized processes to homolateral bronchial spread. This tendency is particularly accentuated on the left side. We can often see that neighbouring segments are involved. Thus we find frequently the combination of the apical and the posterior segment and not so rarely combined with the involvement of the apical lower lobe segment. The latter pattern appears to be typical since we are routinely using lateral tomography. Previously a slight involvement of the apical lower lobe segment easily has escaped our knowledge. The combined involvement of these three segments—"the upper-dorsal syndrome"—is presenting new genetic and particularly therapeutic problems. There is no doubt that the anatomical location of the pathological changes is one of the most decisive factors in the choice of adequate treatment.

By tomography using antero-posterior projection as well as the lateral one we can frequently find the route the infection has taken through the segmental bronchus and over its ostium into the neighbouring segment. A typical finding is the "ostial stenosis" as described by Jones and Alley. Lateral tomography reveals in acute cases wedge-shaped homogenous densities with concave borders connected at the hilum. There is good reason to assume that a stenosing tuberculous process is affecting the bronchial wall in the area between the two or three involved segmental bronchi and their ostia. Reaerisation, at least partial, follows usually adequate treatment. In more chronic changes we can see "hour-glass" pictures with dilatation before the stenosis and behind it.

The infection crawls slowly farther from segment to segment particularly in the dorsal portions. We imagine that a continuous secretion containing a few bacilli flows especially at night in lying position into the basin of the main bronchus wherefrom it moves upwards due to the action of ciliary epithelium of the airways and backwards following gravity. Once a larger cavity is formed producing purulent secretion then the cough mechanism starts to act giving rise to bronchial dissemination far from the originally affected segment. The secretion rich in bacilli is then squeezed into the anterior segments and through the carina into the bronchial tree of the other side. Then we are not dealing any more with a "localized" process.

2) *About one half of our analyzed cases of localized pulmonary tuberculosis in adults are to be considered as reactivations of previous infection mostly originating in infancy.* As a proof of the probable age of a tuberculous process we have taken the incidence of calcifications. A calcified primary complex, however, does not tell us anything about the genesis of a specific lung process present. This may be the result of a real reinfection if the primary infection was biologically healed—the existence of true exogenous reinfections is proved by the fundamental work of Kornel Terplan—or it may be the result of a superinfection through exogenous reception of bacilli at the time of still existing activity of the first infection. Or the recent pathological changes may be due to exacerbation of old

seemingly healed lesions which originated in the period following the primary infection. Our figures recorded in this study show that there was an incidence of 60.5 per cent calcifications in the analyzed group of patients. This fact indicates only a previous tuberculous infection, mostly in infancy. A more exact analysis of these calcifications as to their distribution shows that 92.2 per cent of them are situated on the side of the disease, while 77.8 per cent are to be found within the parenchyma in the involved area. It is reasonable to assume that the presence of calcifications within the area of pathology is not incidental but evidence of genetic connection. Considering only this group of patients with calcifications in the involved area as demonstrated tomographically we find that 47 per cent of all analyzed cases probably present reactivations of old specific changes.

In a similar study published in 1932 the following facts were ascertained based on usual routine x-ray pictures: among 460 cases of open pulmonary tuberculosis in adults calcified foci in the involved area were found in 43.5 per cent. In 17.5 per cent of this group small calculi were expectorated in the course of the disease. Anamnestical data of this "reactivation group" revealed that 54.5 per cent of these patients with calcifications had undergone tuberculous infection in childhood, only 4.5 per cent had been exposed to possible infection in adult age. In the second group of our previous study—in patients without evidence of calcifications in the diseased area—a probable tuberculous infection below 15 years of age could be proved only in 2 per cent, while a possible source of infection in adult life existed in 45.5 per cent of this group.

Our further investigations in this direction made in Czechoslovakia in 1930-1935 (not published) showed that among 943 cases of open pulmonary tuberculosis in adults the source of infection could have been ascertained in 516 cases, i.e. in 54.7 per cent. In this group of 516 patients with known source of infection 270 patients, i.e. 52.3 per cent, acquired their infection before the age of 15 years.

Our present report on patients in Israel reveals similar circumstances. The total number of 60.5 per cent calcifications demonstrated now by tomography corresponds probably to the 52.3 per cent childhood infections ascertained by our epidemiological study 20 years ago. Our present number of 47 per cent calcifications within the involved lung area as demonstrated tomographically in this study is comparable to the 43.5 per cent similar findings revealed in 1932 by usual routine x-ray films. Of course tomographic investigations are somewhat more reliable.

The percentage of calcifications in pulmonary tuberculosis in adults varies in statistics of different countries by using different methods. Thus Medlar found in a study on primary and reinfection tuberculosis as the cause of death in adults a percentage of 43 per cent calcifications in the thoracic lymph nodes (26 per cent calcified and 17 per cent calcified and caseous). Canetti found at necropsy of 301 adults who had died of pulmonary tuberculosis in Paris that the primary glandular focus was stony in 67.7 per cent of cases, chalky in 6 per cent. Even in the 15 to 20 age group half had completely calcified primary glandular sequelae. Canetti's conclusion how-

ever of the "reinfections" in these cases being of exogenous nature is based upon the hypothesis that the scattered small calcifications in the parenchyma many years after the primary infection had to be sterile even more than the calcifications within the primary complex. Our own experience conversely proves that there may be a steady continuation from small fibro-calcific nodules scattered in the lung parenchyma to a progressive pulmonary tuberculosis and that this progression may take a long time, years and even decades. From the pathological-anatomical standpoint Medlar has shown impressively that tuberculous lesions of minimal extent persist in an unhealed state for a long time even when the individual is clinically well. Shadows caused by minimal lesions in the upper lung fields should not be interpreted as "healed" if there are scattered small calcific densities, for the majority of such lesions also contain unorganized necrotic, caseous areas of tuberculous pneumonia.

Also Alex Brinchmann has found in the material of Vardaasen sanatorium (Norway) sure calcific shadows in a quarter of cases. Malmros and Ardell have found in a material collected from Swedish sanatoria among about 7,000 cases calcifications in 31 per cent. These figures are even still more significant as they are presented by Scandinavian authors who for a long time have stated that the interval between primary infection and destructive pulmonary tuberculosis mostly does not exceed three to five years. In these countries large series of cases were published after erythema nodosum and pleuritis. Among 900 such sure primary infections the interval was in 66 per cent shorter than five years, in 33 per cent longer than five years and in 15 per cent longer than 10 years. We have to take into consideration that the epidemiologic character of tuberculosis in the Scandinavian countries is a peculiar one. All the same Ustvedt, one of the authors of the "Scandinavian thesis," is drawing attention to the "late cases" of pulmonary tuberculosis in adults. Recently also Rogstad points to the importance of apparently healed, often calcified lesions in children. They form the origin of pulmonary tuberculosis in adults life to a far greater extent than for many years has been the authorized doctrine. We should likewise not forget that the Norwegian author Andword had stated the theory that there is a constant correlation in successive generations between infant mortality from tuberculosis and the rates from the remainder of life in the same generation. Andword expressed the opinion that if the death rate in the first five years of life for any generation is known it is possible to calculate beforehand what the death rate will be for that generation as it passes through life. It is the infection in infancy which is the fundamental aetiological factor, together with the resulting immunising process, and the occurrence of fatal tuberculosis among adults must generally be considered its secondary or tertiary phase (cit. McDougall).

Our results seem partly to support this theory of Andword. A considerable part of pulmonary tuberculosis in adults, at least 47 per cent, probably more, present reactivations of old latent specific changes which are mostly remnants of a virulent tuberculous infection in infancy. However we should

not generalize. Our results presented in this paper are only valid for this country and for our generation. But tuberculosis changes with time and place. The racial factor may be of some significance as we know that the course of pulmonary tuberculosis among Jews, particularly Jews from Western countries, is in general more chronic. Singer found in 225 x-ray films of Jewish patients compared with the same number of films from non-Jewish patients that in the Jews the majority of the cases were of the chronic type, caseous and pneumonic forms were rare. There was an astonishing frequency of calcifications, primary and secondary. Grzegorzewski has produced evidence to show the effect of environmental factors on the Jewish population of Warsaw during the first and second world wars. The figures show that even Jews with a racial resistance to tuberculosis above the average for humans, can succumb in large numbers if and when the weight of prejudicial environmental factors is heavily loaded against them (cit. McDougall). It seems probable that the relatively high percentage of reactivation tuberculosis in our material is to be attributed to the suffering of a generation of Jews who had undergone virulent infections in infancy in their countries of origin.

It is however noticeable that the figures in this study from Israel do not differ considerably from the figures found in our previous study from Central Europe 20 years ago. The lack of objective criteria does not permit to establish how great is the percentage of pulmonary tuberculosis following directly a late primary infection in adult life. Among our 39.5 per cent of cases without evidence of calcifications in tomography a certain number may be due to direct developement from a late primary infection.

In conclusion we may shortly repeat our view about the morphological phthisiogenesis based on this study: The virulent primary complex offers opportunity to bacillary infection of the bronchial secretions: a) from the primary focus itself, b) from caseous changes in the segmental bronchus belonging to the primary focus, c) from caseous changes in the involved lymph nodes by perforation or penetration into a lober or segmental bronchus as pointed out by Terplan, Schwartz and particularly by the French authors as Lemoin, Dufourt, et al. We know that in about 90 per cent of primary infections tubercle bacilli may be cultured from gastric contents or laryngeal swabs. The paucibacillary character of these cultures seems to point to a more continuous scant excretion of bacilli from specific changes in the bronchial wall rather than from destructive processes in the parenchyma. Many investigations in the last years have proved the presence of mucosal ulcerations accompanying the proliferation of submucosal and mucosal tubercles and thus affording a new pathway for the luminal spread of the infecting organisms both distally as well as proximally. Thus we can explain the incidence of new additional foci later on in the course of an active infection. Topographical analysis suggests in these cases intrabronchial spread mostly by penetration from tuberculous lymph nodes through the wall of the bronchus into the bronchial mucosa (Terplan). Such a microscopic infiltration can be present without a grossly recognizable erosion in or perforation of the bronchial tube. One fact has also to be

taken in account: Terplan shows also cases in which the tuberculous process apparently is still active in the lymph nodes of the primary complex while it has obviously healed in the primary focus (or foci) tributary to the lymph node changes. The new specific changes in the smaller bronchi and their regional lung parenchyma belonging genetically to the same period as the primary complex follow the same regressive changes; they become slowly calcified presenting themselves later as scattered small parenchymal calcifications. If, as frequently happens, the tuberculous process in its progression within the lymphatic vessels involves the lymph glands on the other side, symmetrical changes may be formed on both sides in the upper and dorsal portions of the lungs by the above mentioned mechanism, infiltration into a lobar or segmental bronchus. As a rule in bilateral fibrous-calcific apical changes we are able by means of tomography to bring out the small glandular calcifications on both sides in the hilum or along the trachea. These facts may help to throw light on the pathogenesis of the frequent bilateral fibro-calcific changes in the apex of the lungs.

Of course it is not our intention to deny a real exogenous re- or superinfection as a source of progressive pulmonary tuberculosis in the presence of a more or less healed primary complex, but we are in a single case hardly justified in deciding whether the infection comes from without or is of endogenous origin, i.e. whether the specific changes in the regional lymph nodes are secondary to or causative for the newer lesions or whether both conditions are present. Our own investigations in this study keep the question open for the group of cases in which the calcifications were not situated in the involved area of lung parenchyma.

It is very impressive to reconstruct by means of systematical tomography the development of reactivation tuberculosis in adults. We see the changes on the segmental bronchi—stenosis, obstruction with atelectasis or dilatation with bronchiectasis. Calculi in the course of the involved segmental bronchi may precipitate the excavation of a solid lesion and cause a remarkable tension of the cavity. They may produce complications such as hemorrhages with or without extrusion of broncholiths. The further stages of development do not differ any more from the progression following directly a primary infection.

SUMMARY

A mapping of localized bacillary tuberculosis in the lungs of adults according to the involved broncho-pulmonary segments was performed by means of systematical combined antero-posterior and lateral tomography. Distinction was made between dominant and secondary lesions and their anatomical location was established. The great majority of the dominant lesions is situated in the upper and dorsal portions of the lungs. This fact supports R. C. Brock's thesis on the importance of bronchial embolism and posture in the development of specific changes in the lungs. The distribution of the dominant tuberculous lesions is different from the situation of the primary foci. About one half of the analyzed cases of localized pul-

monary tuberculosis in adults is to be considered as reactivations of previous fibro-calcific lesions generally originating in infancy. There was an incidence of 60.5 per cent of calcifications in the lungs in all analyzed cases: 92.2 per cent of them were located on the side of the disease, while 77.8 per cent were demonstrated within the lung parenchyma in the diseased area. Considering all analyzed cases together we found in 47.0 per cent calcifications delineated tomographically in the involved area of lung parenchyma. In a similar study performed 20 years ago in Central Europe by using standard routine roentgenograms the incidence of calcifications within the diseased tuberculous lung parenchyma was 43.5 per cent. Based upon these facts and the results of other investigations some phthisiogenetic aspects are discussed.

RESUMEN

Por medio de las tomografías sistemáticas antero-posterior y lateral se hizo un estudio de la topografía de las lesiones tuberculosas en los adultos de acuerdo con los segmentos broncopulmonares comprometidos. Se tuvo el cuidado de distinguir las lesiones dominantes y las secundarias y se estableció su ubicación anatómica. La gran mayoría de las lesiones dominantes está situada en las porciones superiores y dorsales. Este hecho apoya la tesis de R. C. Brock sobre la importancia de la embolia bronquial y la postura en el desarrollo de alteraciones específicas pulmonares. La distribución de las lesiones dominantes es diferente de la situación del foco primario. Aproximadamente la mitad de los casos estudiados de tuberculosis pulmonar localizada en adultos ha de considerarse como reactivación de antiguas lesiones fibro-calcificadas que generalmente datan de la infancia. Hubo una incidencia de 60.5 por ciento de calcificaciones en todos los pulmones estudiados. En 92 por ciento de ellos las calcificaciones estaban localizadas en el lado enfermo y en el 77.8 por ciento podieron demostrarse dentro del tejido pulmonar del area enferma. Considerando todos los casos estudiados encoentramos 47 por ciento de calcificaciones delineadas por la tomografía en el pulmón comprometido por la enfermedad. En estudio similar hecho hace 20 años en Europa Central por medio de radiografías standard, la incidencia de calcificaciones dentro del area pulmonar enferma fué de 43 por ciento. Sobre la base de estos hechos y los resultados de otras investigaciones se discuten algunos aspectos tisiogénicos.

RESUME

Un tableau des localisations de la tuberculose sur les poumons de l'adulte en fonction de l'étude des différents segments broncho-pulmonaires a été établi grâce à des combinaisons de tomographies antéro-postérieures et de profil.

L'auteur à distingué les lésions dominantes et les lésions secondaires et en à établi leur siège anatomique. La grande majorité des lésions dominantes se situe dans les portions supérieures et postérieures des poumons. Cette constatation est un argument en faveur de la thèse de R. C. Brock sur l'importance des embolies bronchiques et de la posture dans le développe-

ment des altérations spécifiques du poumon. La localisation des lésions tuberculeuses dominantes est différente du siège des foyers de primo-infection. Environ la moitié des cas analysés de tuberculose pulmonaire de l'adulte doivent être considérés comme des réactivations de lésions fibro-calcaires antérieures dont le début remonte généralement à l'enfance. Dans les poumons de tous les cas analysés, il y à eu des proportions de 60.5% comprenant des calcifications. 92.2% parmi elles étaient situées du côté ou s'était développée l'affection. 77.8% apparaissaient au sein même du parenchyme pulmonaire dans la région atteinte. Considérant tous les cas étudiés, l'auteur constate que dans 47% d'entre eux, on peut mettre en évidence par la tomographie des calcifications dans la région pulmonaire atteinte.

Dans une étude comparable pratiquée il y a 20 ans en Europe Centrale; pour laquelle avaient été utilisés simplement les films standard, la fréquence des calcifications au sein du parenchyme pulmonaire atteint par la tuberculose s'était montrée de 43.5%. Sur la base de ces constatations et des résultats d'autres recherches, l'auteur discute certains problèmes de phtisiogénèse.

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The Clinical Problem of Infected Cystic Disease of the Lung

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Infection of areas of the lung containing multiple small cysts gives rise to a definite chain of events, and to certain changes which can be recognized. Treatment is excision of the involved pulmonary tissue, and cure is the usual result. Although the literature is full of articles on pulmonary cysts practically no attention has been given to the problem of superimposed infection of cystic areas. In this article the clinical problem as seen in 26 cases during the last five years will be discussed.

Of the 26 cases, nine had resections done of the involved areas. Two had exploratory thoracotomies and were found to have too extensive involvement of their lung to permit resection. The others had the diagnosis made on the basis of history and roentgen ray studies. The nine patients in whom resections were done had their disease limited to one lobe, or a portion of it. In every instance there was evidence of multiple cysts with obvious infection in them, and in the adjacent tissue. The rest of the lung appeared normal. In one instance the disease was confined to the lower segments of the left lower lobe and the superior segment was normal.

Clinical Picture

No attempt will be made to report in detail all of the cases in which we did resections but typical examples will be presented and discussed. At the end of the article will be appended the summaries of all of the resected cases.

The youngest patient was a girl of three who became sick three days after being vaccinated. She seemed sick, had fever and generalized lymphadenopathy. She was given penicillin and sulfonamides with prompt drop in her fever. Recurrence of symptoms in a short time was treated with larger doses of penicillin, but she developed a cough and had some shortness of breath and was admitted to the hospital. On admission it was noted that she had moist and crepitant rales over the left lower lobe and a roentgenogram showed a mottled density of the left lower lobe, with some small patches of partial aeration (Figure 1). She was again treated with penicillin and sulfonamides and temperature dropped to normal in four days, and stayed there for three days, when she was discharged from the hospital. The next day her temperature was again elevated and she vomited and began coughing more frequently. She was readmitted to the hospital. The physical signs over the left lower lobe had returned and the roentgenogram of the chest suggested the addition of pleural fluid to the previous shadow. Thoracentesis failed to reveal any fluid. The child gradually improved but the roentgenograms showed no appreciable change and it was decided that she had infected cystic disease. She was

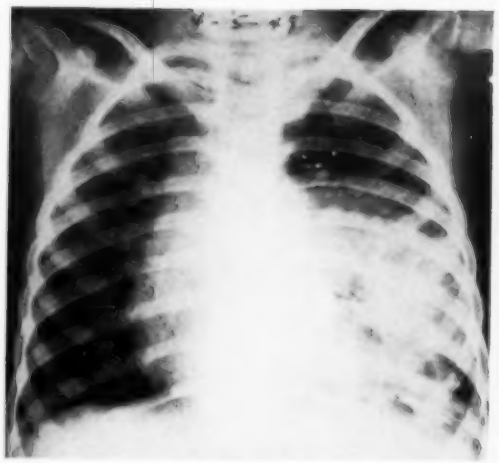

FIGURE 1

FIGURE 2

Figure 1: Roentgenogram of chest of patient, Case 1.—*Figure 2:* Photograph of specimen of lobe removed at operation, Case 1, showing numerous small cysts scattered throughout the lobe.

discharged from the hospital again to convalesce at home preparatory to operation. She remained at home for a month in good condition without evidence of a recurrence of her pneumonitis although she had occasional temperature elevations. She was admitted to the hospital on June 14, 1949 and operation was done the next day. An extensively diseased left lower lobe was found and removed, but she developed pulmonary edema and died.

Examination of the specimen (Figure 2) showed evidence of fibrosis of the lung with a cyst, lined with fibrous membrane, about 3 cm. in diameter in one area, and in the upper part of the lobe numerous dilated cystic spaces ranging up to 1.5 cm. in diameter. These cysts contained a mucopurulent material, or yellow viscid material. Another area of the lobe was moderately soft and hyperemic. Microscopic examination showed the lung tissue to be fibrous and with many areas of infiltration with inflammatory cells. The walls of the cysts were seen to be thin and to contain infiltrations of polymorphonuclear leukocytes, lymphocytes, and erythrocytes. Some of the cysts were lined with epithelial cells.

The next child was four. He had had a harsh cough ever since he had bronchitis at the age of one and a half. He had a second attack of bronchitis a year after the first but had been perfectly well otherwise. Because his mother had recently been in a sanatorium for tuberculosis a roentgenogram of his chest was taken. This showed a shadow in the left lower lobe which was thought to be due to tuberculosis (Figure 3), but his tuberculin was negative, and studies of his gastric washings for tubercle bacilli failed to show any growth on cultures, or to produce tuberculosis in a guinea pig. Roentgenograms were repeated with no change being noted. Bronchoscopy was done with normal findings. It was decided that the child probably had infected cystic disease and was admitted to the hospital for operation. When the chest was opened a firm mass was felt in the anterior part of the left lower lobe. The superior segment of the lobe was preserved, and the rest removed. His recovery was uneventful and he has remained well in the 18 months since then. Examination of this specimen (Figure 4) showed that most of the resected lobe was consolidated, and on section multiple cysts or abscess spaces were seen, containing much greenish gray, purulent material. After exacuation of this material some of the cystic areas appeared to be lined by mucous membrane while the lining of others was granular. The intervening lung tissue appeared to be consolidated. Microscopic examination confirmed the gross findings. The larger cysts were lined with columnar, mucoid epithelium which showed extensive ulceration and replacement by a considerable amount of exudate. Other areas of the lung showed many foci in which alveoli were completely, or partially filled, with masses of polymorphonuclear leukocytes, lymphocytes, and erythrocytes, as well as groups of lipid containing macrophages. In these areas there was an increase in fibrous tissue as well as an accumulation of erythrocytes. Bronchi and bronchioles contained considerable purulent material with ulceration of the epithelium.

A third case was that of a 43 year old man who had had long standing respiratory symptoms with several episodes of pneumonia when he was

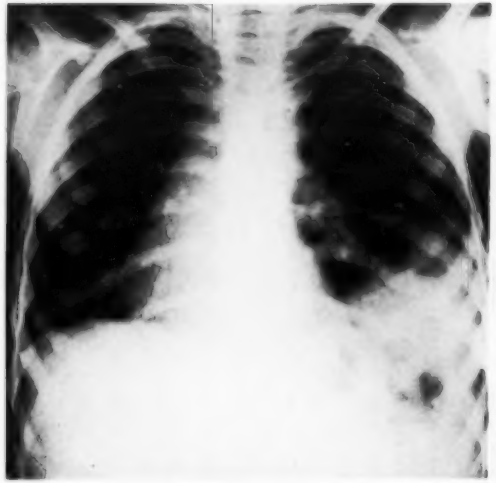

FIGURE 3

FIGURE 4

Figure 3: Roentgenogram of patient, Case 2.—*Figure 4:* Photograph of sections of the lobe removed at operation, Case 2, showing the presence of many small cysts.

admitted to the hospital on April 17, 1950. In July 1949 he had pneumonia followed by empyema and had recovered after surgical drainage had been established. However, he continued to cough and raised sputum which was yellow or white, and mucoid in type. In the week prior to this admission he felt sick and had fever up to 103 degrees F. On admission he appeared acutely ill. His temperature was found to be 103 degrees F., and there was dullness over his right lower lobe with diminished breath sounds. After administering antibiotics for four days his temperature fell to normal. Roentgenogram (Figure 5) showed a shadow extending up from the right base with decreasing density. The costophrenic angle was blunted and there seemed to be a fluid level lateral to the vertebral column. It was thought that this picture suggested cystic disease of the lung. Operation was carried out three weeks after admission. Many adhesions were found over the entire right lower lobe, as well as over the middle lobe, and laterally over the upper lobe. Fissures between the lobes were obliterated by fibrous adhesions. The lower lobe was indurated in the region of the bronchus and laterally, and there were several enlarged hilar lymph nodes. In the periphery of the lobe was a cyst which was opened when the lobe was being separated from the chest wall. From it escaped thick yellow, viscid fluid. The lobe was removed. On studying the specimen it was seen that there was moderate anthracosis (Figure 6). Many areas of the lobe were quite firm, and on section a cyst was found in the upper part which measured 6 cm. in its greatest diameter and had a smooth inner lining. The wall of the cyst was thin but the surrounding lung tissue showed evidence of fibrosis. In the lower part of the lobe there was considerable consolidation with multiple small, irregular cystic structures containing light green purulent material. There was evidence of fibrosis in the surrounding lung. No definite communication between the cysts and bronchi could be seen. On microscopic examination the main cyst wall was seen to be comprised of dense fibrous tissue and the seat of considerable chronic inflammation. No definite epithelial lining was noted. Elsewhere the lung tissue showed multiple small cysts lined by columnar, mucoid epithelium, resembling that lining bronchi. In these areas there was no residual evidence of bronchial structures and the lung tissue was replaced by dense fibrous tissue and the seat of varying amounts of acute and subacute inflammatory reaction. In some places the cysts contained a considerable amount of exudate composed largely of polymorphonuclear leukocytes. Elsewhere the large bronchi showed hypertrophy of the muscularis and fibrosis of the wall with varying degrees of acute and chronic inflammatory reaction. Comparatively little of the lung parenchyma could be considered to be normal. Following operation he made a good recovery but the pleural space was slow in being obliterated and the phrenic nerve was crushed to allow the elevated diaphragm to help obliterate the space. When seen recently, a year after his operation he was in good health.

The other patients were adults and presented quite similar histories. Some had episodes of acute pneumonia with clearing of symptoms but with no clearing of the shadow in the roentgenogram, following use of

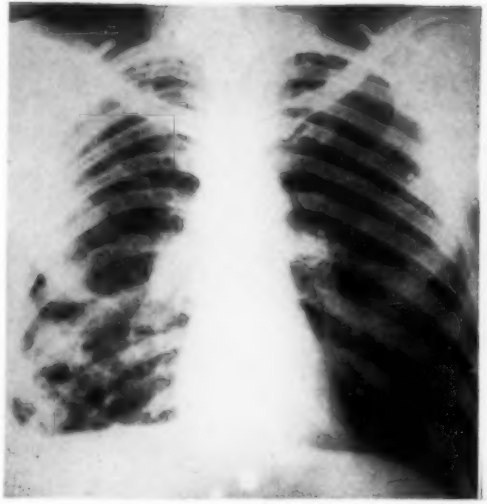

FIGURE 5

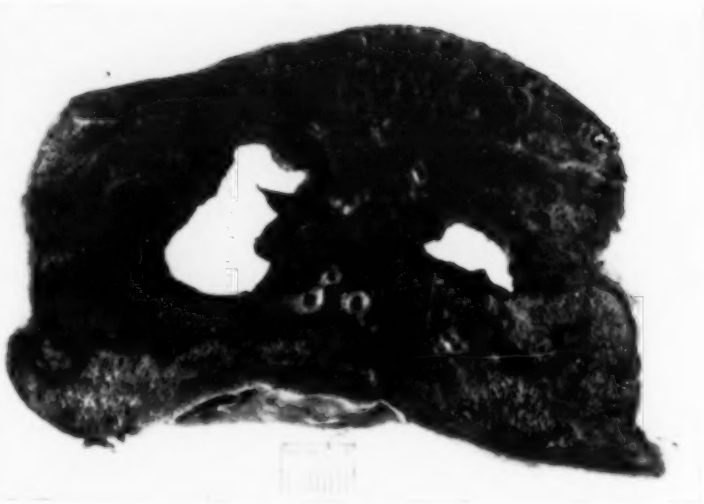

FIGURE 6

Figure 5: Roentgenogram of chest of patient, Case 3.—*Figure 6:* Photograph of section of lobe removed at operation, Case 3, showing a large and many small cysts.

antibiotic therapy. Others had symptoms and signs suggesting lung abscess, and some had no acute symptom but chronic cough with expectoration of mucoid material, and occasionally of blood. In all instances after the subsidence of the acute symptoms cough persisted and the roentgenograms showed little change in the appearance of the lung. Bronchoscopy was done in all cases but only showed evidence of localized bronchitis. Bronchograms were of value in ruling out bronchiectasis. They usually showed a failure of filling of the bronchi in the region of the shadow, and at times there was distortion of the bronchial pattern as if the bronchi were pushed aside by a radiolucent mass. These findings were in accord with what was found on examining the specimen where it was seen that the bronchi did not run out into the cystic area, and at times the cysts were large enough to displace the terminal bronchi.

Summary of Pathological Changes Found in Specimens

Dr. C. Allen Payne, pathologist at Blodgett Memorial Hospital where almost all of the patients were operated upon, has reviewed the specimens and written the following report: "The specimens from the nine cases consisted of a single lobe in all instances except one when the left lower lobe except for the superior segment was removed. Six were from the right lung and three from the left. The upper lobe was involved in five cases and the lower in four. Pleural adhesions were usually extensive and fibrous, and in most cases the lobes were either atelectatic, or involved in much fibrosis. Dissection of the specimens revealed from four to many cysts varying in diameter from one to six centimeters, and containing purulent or mucoid material which sometimes had a foul odor. Usually the lining was smooth although in two cases it was distinctly granular. In many areas the lining was ulcerated and covered with exudate. In only two cases could a definite communication between a bronchus and a cyst be made out. In two cases there was additional evidence of emphysema.

"Microscopically all of the cysts were lined by columnar epithelium identical with that of the bronchi. In the larger cysts there were many areas of ulceration with a covering of purulent exudate. In the larger cysts areas of the epithelium became transitional and stratified, probably as a result of the associated infection of long standing. Peripheral to the epithelium the wall was composed of rather vascular fibrous tissue of variable thickness and revealing rather marked purulent and chronic inflammatory reaction. The wall of the cysts could be definitely differentiated from the walls of the bronchi by the lack of muscle and mucoid glands. In addition to the cysts seen with the naked eye the microscopic sections revealed smaller cysts of similar character. The surrounding lung parenchyma in nearly all cases revealed marked fibrosis, many areas of pneumonitis and varying degrees of pneumonia. These findings indicate that the process has been active for a considerable period of time."

Pathogenesis

It is not our wish to enter into the controversy over the exact nature of the cysts, or rather of their origin. From a clinical standpoint it makes

little difference to the patient whether the cysts are of congenital, or inflammatory origin. We believe that they are of congenital origin as mentioned before and we believe that they have been present in the patient's lung since birth. If infection did not occur these areas would never be recognized as they are not large enough as individual cysts to be recognized in roentgenograms, and the amount of lung tissue replaced by them is rarely extensive enough to interfere with pulmonary function. When they become infected symptoms are produced, and as they do not disappear promptly roentgenograms are taken which reveal definite shadows. Even though the antibiotics usually succeed in suppressing the infecting organisms the tissue being abnormal in the beginning cannot return to normal. These areas of cysts seem to have less resistance to infection than normal parts of the lung and once infected tend to remain in that condition. As the inflammatory reaction persists, and extends, the individual cysts lose their identity and become fused into a single abscess. In several of our cases there were areas of multiple small and one, or two, large infected cysts. Whether these large ones represent the coalescence of many small ones, or the persistence of large ones that later became infected cannot be determined from our material.

Diagnosis

An acute pneumonitis marked the onset of symptoms in practically all of our patients. At that time the diagnosis was always pneumonia. Roentgenograms showed shadows that were consistent with the diagnosis of virus pneumonia, but in a few instances there were radiolucent areas which suggested the presence of cysts. Under the usual care for pneumonia symptoms subsided, but in all instances there was little evidence of change in the roentgen appearance. This persistence of a shadow in the roentgenogram supported the diagnosis of virus pneumonia, and it was not until many weeks later that the persistence of the roentgen ray changes indicated that this diagnosis would not suffice. Following the subsidence of the acute symptoms suggesting pneumonia, the patients continued to cough and most of them raised sputum. In a few instances blood was mixed with the sputum, or coughed up in small quantities. Some of the patients had localized chest pain. Fever and malaise were even less common. With the persistence of the roentgen ray changes the patients were referred to us.

Differential Diagnosis

In the absence of roentgenograms showing definite areas of multiple cysts, the diagnosis could not be established until the involved lobe was removed. In the great majority of our cases the correct diagnosis was our first choice before operation but other diagnoses also had to be considered. In many cases it is most important to rule out tuberculosis as the cause of the condition. As was stated above, tuberculin testing, sputum studies, and the culturing and guinea pig innoculation of bronchial secretions, or of gastric washings must be done. A chronic suppurative pneumonitis without cysts can give very similar findings, and the diagnosis made only

after study of the specimen. A chronic lung abscess, especially if it is multilocular may closely simulate infected cystic disease. The clinical course, and the roentgen ray appearances are much alike. Other types of localized pulmonary infection which run chronic courses, whether due to bacteria or fungi, cannot be excluded. Bronchiectasis can be ruled out by means of the bronchogram, but the possibility of carcinoma can only be determined at operation. When roentgenograms, which have been taken in the past, are available for comparative study, it is often possible to discover small linear shadows which were present in the area of the present large shadow, and which were considered to be of no significance at that time. In retrospect these linear shadows can indicate the presence of one or more cysts. They are so indistinct that on viewing the film without the knowledge of the subsequent course of events one could not make the correct diagnosis. But with this knowledge these earlier films can be very useful.

Treatment

Regardless of the diagnosis it is imperative to operate upon patients who have a persistent, localized roentgen ray shadow in a lung, which has not been found to be associated with evidence of tuberculosis, or of other infection amenable to medical therapy. For infected cystic disease of the lung excision of the involved area is curative. Whenever possible, only the part of the lobe containing the cystic disease should be removed, but in our cases this was possible in only one instance. When there is doubt about the diagnosis, or most of a lobe is involved, we believe that it is wiser to do a total lobectomy. In our experience no other area of cystic disease was found at operation, or has become apparent since. We believe, however, that cystic disease is not always confined to one lobe, and that as our experience broadens we will encounter cases with multiple involvement, and that some of the patients who have had evidence of a single lobe involvement will later give evidence of the disease elsewhere.

Summaries of Case Histories of Patients Having Resections

Case 1: R. B. was a 37 year old man who was first admitted to Blodgett Memorial Hospital on February 22, 1947. He had not felt well since the previous April. He had lost 17 pounds, had had night sweats, and a cough productive of mucus with occasional flecks of blood. He had had some pain in his left chest and had felt tired. Roentgenogram showed a shadow extending out from the hilum to the periphery of the left mid lung field. Bronchoscopy revealed reddening of the mucus membrane of the left bronchus and mucopurulent material was seen to escape from the left upper lobe bronchus. A bronchogram showed a filling defect in the area of the shadow. Infected cystic disease was considered to be the most likely diagnosis, and after he had improved under penicillin therapy he was sent home to prepare for operation. He was readmitted on March 26, 1947 and operation was performed on April 2. An irregular mass was felt in the anterolateral part of the left upper lobe with induration about it. The lobe was densely adherent to the adjacent structures. The lobe was removed and on examination of the cut surface five or six irregular cystic structures were seen embedded in a fibrous parenchyma. The cysts were filled with fould smelling gray, groumous material, had smooth linings, and several were seen to be lined with columnar epithelium with multiple areas of erosion or ulceration and some areas showing squamous metaplasia.

Case 2: D. B. was a 23 year old woman who was admitted to Blodgett Memorial Hospital February 7, 1948. About two and a half months before she had begun to cough and have fever. The cough became worse and was productive of small amounts of mucoid sputum. A month ago she raised a small amount of blood, and did so again four days later. Roentgenogram at this time showed a density in the right upper lung field. After admission to the hospital she was bronchoscoped and the mucus membrane of the right upper lobe bronchus was seen to be red and edematous. Mucopurulent secretion escaped from the bronchus. Streptomycin was then added to the penicillin which she had been receiving and the temperature became normal. A tuberculin skin test with O.T., 1/1000 was negative. The diagnosis was obstruction to the right upper lobe bronchus by tumor, or foreign body. Operation was performed on February 26 and the right upper lobe was found to be the seat of a large abscess with marked surrounding pneumonitis involving the upper and posterior part of the lobe. The lobe was densely adherent to the chest wall. Lobectomy was done. The specimen showed the bronchi to be filled with tenacious mucous material and their walls were hyperemic and hemorrhagic. The parenchyma was fairly firm. There were a number of abscesses filled with the same material as the bronchi. The largest was 4.5 cm. in greatest diameter and the others 2 to 3 cm. Their walls were of dense fibrous tissue. On microscopic examination it was seen that the abscesses were cysts and the largest was lined with columnar mucoid epithelium, and resembled the bronchial mucosa. Others were lined with thin, irregular layers of stratified squamous epithelium. Large areas had no epithelial lining but were covered with exudate consisting of fibrin and masses of polymorphonuclear leukocytes. The smaller cysts were all lined with columnar epithelium and currounded by finromuscular tissue resembling the bronchial wall. She was discharged in good condition nine days after operation and has remained well.

Case 3: V. P. was a 45 year old man who was admitted to Blodgett Memorial Hospital on April 14, 1949. He had a chronic cough for many years. The preceding July he had had an acute attack of illness with fever, chest pain and a productive cough. Roentgenogram showed a dense shadow in his right upper lobe area and he was thought to have pneumonia. With penicillin therapy he recovered promptly from his acute illness but cough persisted and the roentgenogram continued to show a shadow in the same area with evidence of cavitation. Before admission to the hospital he was bronchoscoped with negative findings and the bronchial secretions showed no tumor cells. A bronchogram was negative. With a diagnosis of infected cystic disease he was operated upon on April 19, 1949. The right upper lobe was almost solid and completely airless. What resembled an abscess cavity reached the periphery of the lobe and was opened into when separating the lung from the chest wall. The lobe was removed and the phrenic nerve was crushed. On examination of the specimen the lung seemed to be the site of unresolved pneumonia or fibrosis. Throughout the lobe there were multiple, irregular cystic lesions averaging 1 to 4 cm. in diameter. The larger ones contained coagulated albuminous material. The walls of the cysts were thick and fibrous at some points and thin at others. At some points the cysts seemed to communicate with the bronchi. On microscopic examination many areas of the lung showed cystic lesions which contained varying amounts of fibrinous and purulent exudate. Only at a few points could an epithelial lining be identified, and there it was columnar in nature, but showed small foci of metaplasia. Purulent exudate covered the lining of the cysts at most points. The cysts were surrounded by a thin wall of fibrous tissue. The adjacent lung tissue showed rather marked fibrosis at some points and other areas contained many groups of polymorphonuclear leukocytes, erythrocytes, and albuminous material. In at least one area there seemed to be a communication between a cyst and a bronchus.

Case 4: M. R. See report of first child in body of article.

Case 5: L. R. See third case reported in body of article.

Case 6: P. K. See report of second child in body of article.

Case 7: T. R. was a 46 year old man who was admitted to Blodgett Memorial Hospital on July 27, 1950. About four months ago he had a cold with general weakness, fatigue, mild fever and cough. He lost his appetite and his weight decreased 20 pounds since then. He had had a tight sensation in his right lower chest and some dyspnea on exertion. The cough was occasionally productive of mucus and once there was some blood. Roentgenogram revealed a shadow at the right base with some radiolucent areas suggesting cysts. Bronchoscopy showed mild redness of the right bronchial mucosa, and a bronchogram showed partial filling of the cystic areas. Operation was done on July 29. The lower lobe was found to be firm in some areas and cystic in others. The specimen showed diffuse anthrocosis and well aerated parenchyma with a number of groups of cysts having thin walls. The cysts contained small amounts of light gray purulent material but had smooth linings except for trabeculation. Some areas of the surrounding parenchyma showed varying degrees of consolidation, some of which resembled pneumonia. The cysts varied in size from 1 to 4 cm. in diameter, and were irregular in outline. Microscopically they showed extensive acute inflammatory reaction with many foci of necrosis. The smaller cysts were lined by definite layers of columnar epithelium. Surrounding the large cysts there was an increase in fibrous tissue. Other areas had some resemblance to emphysema with fibrosis of the walls of the coalesced alveoli. No definite communication noted between the cysts and the bronchi. He was discharged on August 9 with some fever and some fluid in his chest. A month later he was readmitted because of empyema and nonexpanded lung. Closed drainage was not successful and an open operation with decortication and partial thoracoplasty was done on September 21. He was discharged on October 15, 1950. Recent check-up shows him to be in good health.

Case 8: E. H. was a 44 year old man who had had a cough for a year. Two months before admission to the hospital he had raised some bright red blood, and had continued to raise bloody or brownish sputum since then. He also had had some pleuritic type pain in his right anterior chest. He had developed some dyspnea on exertion, loss of strength, and appetite. A roentgenogram showed an indefinite shadow in the right upper lobe and he was admitted to the county tuberculosis sanatorium (Sunshine Sanatorium) for study. These studies for tuberculosis were negative, including a tuberculin test. On bronchoscopy purulent secretion was seen to come from the right upper lobe bronchus. A bronchogram showed incomplete filling of the right upper lobe bronchi. He was admitted to Blodgett Memorial Hospital for operation with a diagnosis of tumor, tuberculosis, or a chronic nonspecific inflammatory mass. On August 10, 1950 the right upper lobe was found to be the site of a chronic inflammatory process and it was removed. The specimen showed evidence of heavily infected cystic disease. He made an uneventful recovery and was discharged 12 days later.

Case 9: F. C. was a 38 year old negro who developed pain in his right flank and went to see his doctor. Evidence of a pneumonic process in his right lung was found and treatment for pneumonia given. He recovered from the acute illness but his cough persisted and he raised some pus and blood. On his own request he was sent to the City Chest Clinic and a roentgenogram of his chest was taken. This showed a shadow in the right upper lobe that was interpreted as being due to tuberculosis, and he was admitted to the county tuberculosis sanatorium. Here studies for tuberculosis were all negative and further roentgenograms suggested the diagnosis of infected cystic disease of the lung. A bronchogram had shown failure of filling of the right upper lobe bronchi in the area of the shadow seen in the roentgenogram. He was admitted to Blodgett Memorial Hospital. The right

upper lobe was found to be the site of an inflammatory mass occupying most of the lobe, and was removed. On examination it was found to be the site of extensive cystic disease with infection, and there was no evidence of tuberculosis. Convalescence was prolonged because of the slow filling of the pleural cavity with the remaining lobe, but a year after the operation, he was in good health with no evidence of pulmonary disease.

Discussion

Infection of areas of cystic disease has undoubtedly occurred since the beginning of human history. Many surgeons and pathologists have certainly seen it, and even described it, but as a clinical entity little attention has been paid to it. Because of our operative experience with 11 cases and study of 15 others we have become interested in the condition, and feel that more attention should be given to it. Solitary cysts, found on routine roentgenograms, or producing symptoms, are readily removed and give happy results. Many papers have been written about them. Infected solitary cysts have been frequently confused with abscesses, or even empyema. In the past, when abscesses were only drained this confusion of an infected cyst with a simple abscess was most disappointing, and papers were written about them. Pulmonary cysts which rupture and give rise to spontaneous pneumothorax are readily removed, or otherwise treated, with excellent results. Even cases in which there are multiple cysts, and bilateral cysts, are amenable to surgery, and the chances for great improvement are good. Only in those rare instances where there is a true diffuse cystic condition of both lungs, with minute or large cysts, is the outlook for treatment hopeless.

The pathogenesis of pulmonary cysts has been discussed in the literature from every angle, and we have no desire to enter the debate. Whether the condition which we have described as infected cystic disease is the result of infection of a congenitally cystic area of the lung, or is an area of chronic

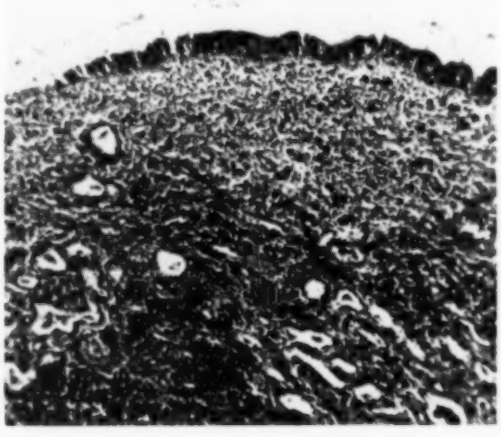

FIGURE 7: Photomicrograph of section of wall of typical cyst X 40. It shows the clumnar mucoid epithelium lining the cyst, the fibrous nature of the wall, and the infiltration of the wall with inflammatory cells.

pneumonitis with cystic changes as a result of the infection, we cannot say. Most of the sections from the areas of cystic disease which we have removed at operation have shown multiple small cysts, lined with columnar epithelium resembling the lining of bronchi (Figure 7). We are aware of the observation of Potts[1] and his associates on the development of pulmonary cysts in the lungs of infants following recovery from staphylococcus pneumonia, but they are solitary cysts, and of considerable size. We believe that the areas of small cysts which we have encountered, and found to be infected, are congenital in origin. Whether or not a pulmonary cyst is of some other origin it is well known that when they become infected, they rarely, if ever, return to their former state. It would seem that congenitally abnormal tissue is less resistant to infection than is normal tissue. Another patient on whom we operated with a diagnosis of infected cystic disease of the lung was found to have a chronic pneumonitis involving the lingula of his left upper lobe. The entire lobe was without pigment and appeared to be foetal. Microscopic studies confirmed this impression. One factor that would seem to hinder the natural defense of the cystic area, or of foetal lung, is the absence of functioning cilia. In both areas there was absence of recognizable bronchioles, and terminal bronchi.

There can be little difference of opinion as to the treatment of infected cystic disease. Excision, with salvage of as much normal lung tissue as possible, seems obvious. There is no evidence that cystic tissue, once infected, can completely lose this infection, or long escape reinfection. And any patient who harbors such a lesion cannot hope for restitution to normal with his lungs intact.

In establishing the diagnosis the most important point is awareness of the possibility of the lesion being present. With this in mind more and more cases of chronic localized pneumonitis will be found to be due to infected cystic disease. Since this paper was presented, ten more patients with infected cystic disease of the lung have been treated by pulmonary resection with good results in all.

SUMMARY

A study of the clinical problem of infected cystic disease of the lung has been presented, based on the study of nine cases in which resections were done, two on whom exploratory operations were done, and on 15 other cases not verified by operation. The infection of areas of cystic disease produces symptoms which are usually considered to be due to virus pneumonia until it is observed that the roentgenographic changes persist. Tuberculosis, and other chronic inflammatory processes, can produce similar signs and symptoms. In all resected cases columnar, mucoid epithelium was found to line some of the cysts. Others had squamous cell lining, or only a lining of inflammatory cells. The walls were fibrous and did not contain muscle or cartilage. In two of the cases a communication between some of the cysts and terminal bronchi was observed. Evidence of a marked inflammatory reaction was present in every lobe resected.

1 Potts, W. J. and Riker, W. L.: *Arch. Surg.*, 61:684-695, October 1950.

The only satisfactory treatment is resection of the involved tissue. In our nine cases total lobectomy was done in eight, and a subtotal in one. There was one death, in the youngest patient, as a result of pulmonary edema.

RESUMEN

Basándose en el estudio de nueve casos en los que se hicieron resecciones, se ha hecho un estudio del problema clínico de los quistes infectados del pulmón. En dos de los casos se hizo una operación exploradora. Ademas el estudio comprende otros 15 casos no verificados por la operación.

La infección de áreas de enfermedad cística produce síntomas que generalmente son consideradas como debidos a neumonía de virus hasta que se observa que los cambios radiológicos persisten. La tuberculosis y otras afecciones inflamatorias crónicas pueden producir signos y síntomas similares. En los casos sujetos a resección se encontraron los quistes recubiertos de epitelio mucoide columnar en algunos quistes. Otros tenían cubierta de celdillas escamosas o solamente una capa de celdillas inflamatorias. Las paredes eran fibrosas y no contenían músculo o cartílago. En dos de los casos una comunicación entre algunos de los quistes y bronquios terminales se observó. En todos los lóbulos resecados se encontraron evidencias de reacción inflamatoria marcada. El único tratamiento satisfactorio es la resección del tejido afectado. De nuestros nueve casos en ocho se hizo lobectomía total y subtotal en uno. Hubo una muerte, en el enfermo mas joven, po redema pulmonar.

RESUME

Les auteurs présentent une étude du problème clinique de la maladie kystique suppurée du poumon. Ils ont étudié neuf cas dans lesquels furent réalisées des exérèses, dont deux furent l'objet d'une intervention exploratrice, et quinze autres cas qui ne furent pas vérifiés par opération. L'infection de la zone kystique est à l'origine de symptômes que l'on attribue habituellement au virus pneumonique tant qu'on n'a pas constaté que les modifications radiologiques ne tendent pas à disparaitre. La tuberculose et d'autres atteintes infectieuses du poumon peuvent réaliser un tableau clinique comparable. Dans tous les cas opérés, un épithélium mucoïde délimitait quelques-uns des kystes. D'autres avaient une limite constituée par du tissu épidermoïde, ou plus simplement une limite constituée par des cellules inflammatoires. Les parois étaient fibreuses, et ne contenaient ni muscle ni cartilage. Dans certains cas, les auteurs remarquèrent une communication unissant certains des kystes et les bronches terminales. Dans tous les lobes réséqués, ils parurent faire la preuve d'une réaction inflammatoire importante. Le seul traitement satisfaisant est l'exérèse du tissu étudié. Sur les neuf cas présentés, huit subirent une lobectomie totale, un une lobectomie partielle. Il n'y eut qu'une mort chez le plus jeune des malades, à la suite d'un oedème pulmonaire.

Prevention of Iodism in Bronchography by Use of ACTH. Case Report*

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Fatal reactions following instillation of iodized oil into the tracheobronchial tree fortunately are rare. However, iodism manifested by urticaria, swelling of the salivary glands, and occasional asthma is not infrequent and often precludes additional bronchographic studies, as well as proving a source of annoyance to the patient. When these reactions occur they begin shortly after the instillation of the oil and do not subside for 24 to 48 hours. There may be no previous history of allergy or drug sensitivity, particularly in those cases manifesting lacrimal gland enlargement. A skin eruption occurring two to three weeks afterward has been noted occasionally in persons with non-allergic histories. It is thought that this condition is a manifestation of drug idiosyncracy instead of allergy.

The following case history illustrates iodism in a young man and its control with ACTH, thereby permitting additional bronchographic studies without signs of iodism:

T.E.B., a white male farmer, age 29, was admitted to the Veterans' Administration Hospital, Fayetteville, Arkansas, October 17, 1951 because of pain in the right chest and a history of recurrent pneumonia in the lower part of the right lung. His initial episode of pneumonia had occurred in 1943, with eight yearly recurrences involving the same lung area. His complaints had begun one month prior to admission and consisted of recurring chills and fever, a weight loss of 20 pounds, and a cough productive of one-half teacupful of yellow sputum daily.

The physical examination revealed a tall, well-developed, well-nourished white male without respiratory distress. He had a loose, moist, bubbling cough, productive of a small amount of yellow sputum. Increased tactile fremitus and roughened breath sounds were present over the right lower lobe. Fine crepitant rales were found throughout both lung fields. There was a rough to and fro friction rub over the right anterior surface of the chest. The remainder of the examination was within normal limits. The clinical impression was that the patient had right middle and lower lobe pneumonia secondary to bronchiectasis.

Clinical course: Laboratory studies showed a leukocytosis of 15,300, with a differential count consisting of 78 per cent neutrophils, 20 per cent lymphocytes, 1 per cent basophile, and 1 per cent eosinophile. The sputum examination was negative for acid-fast bacilli. The urinalysis was essentially normal except for one plus albumin and occasional clumps of white blood cells. A teleoroentgenogram of the chest demonstrated a honeycomb pattern in the right lower and possibly right upper lobe, as well as in the region of the left hilum. Dr. Marvin Westfall, Veterans Administration Hospital roentgenologist, believed the x-ray appearance to be compatible with bronchiectasis involving both lung fields.

*From the Department of Internal Medicine, Veterans Administration Hospital, Fayetteville, Arkansas. Reviewed in the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the authors are the result of their own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

Following admission to the hospital he was confined to bed and given antibiotic therapy, and general supportive measures with salutary results. He gradually became afebrile, the cough subsided, and the local chest signs decreased greatly during the next nine days. On October 26, 1951 lipiodol was instilled into the right bronchial tree by the tracheal intubation method (see Figures 1A and 1B). All lobes on the right displayed extensive saccular dilatation. He had no complaints at the time this procedure was performed. However, the following morning he complained of a sore throat, manifested marked swelling of the submaxillary glands, generalized urticaria, and had a fever of 101.5 degrees F. Pyribenzamine, 100 mg. every fourth hour for 48 hours was prescribed, with subsidence of most of the signs and symptoms of iodism.

In view of the demonstrated bronchiectasis on the right it was thought that a lipiodol study of the left bronchial tree was indicated. Since it was imperative to prevent the recurrence of iodism following the anticipated second lipiodol instillation, it was decided to prepare the patient for this procedure with ACTH. Therefore, on October 30, 1951 a Thorn test was performed using the chamber count method. It was found that there were 285 circulating eosinophiles per cubic millimeter prior to the administration of 25 mg. of ACTH intramuscularly, with a satisfactory drop to 143 eosinophiles per cubic millimeter four hours after the injection. Since this was a normal response 25 mg. of ACTH was given intramuscularly on the afternoon of November 1, 1951. Following this, lipiodol was instilled into the left lung using the same technique as previously employed. The resultant

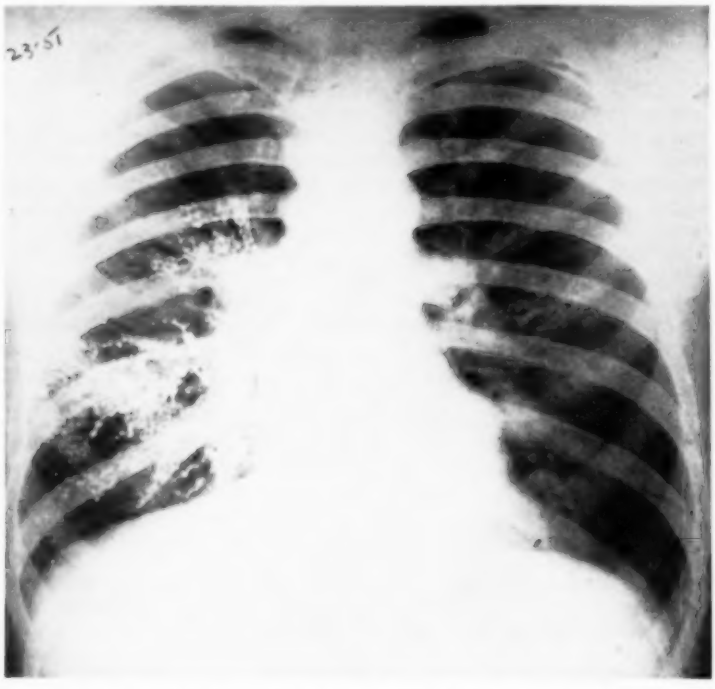

FIGURE 1A (October 26, 1951): Chest x-ray film. Postero-anterior view in the case of T.E.B. demonstrating the extensive mixed bronchiectatic involvement of the entire right bronchial tree.

bronchogram revealed marked saccular bronchiectasis of the left upper and lower lobes, including the lingula (see Figure 1C). The patient had no untoward reaction following this procedure except for a slight subjective sore throat on the ensuing morning. On physical examination no irritation of the pharyngeal membrane was evident. However, it was decided to administer another 25 mg. dose of ACTH at this time with complete abatement of the symptom one hour later, which state was maintained throughout the remainder of his hospital stay. In view of the marked reaction to the initial procedure, and since 20 cc. of 20 per cent lipiodol were used for each bronchial visualization, there was every reason to anticipate the possibility of a similar reaction had there been no protection by ACTH. It was conjectured that the ACTH provided the same cellular immunity to the untoward action of iodine as it had shown in other systemic allergic phenomena.

Discussion

This patient was not given oral iodine prior to the first bronchogram as a test for iodine sensitivity. This procedure probably should be done in all cases where bronchography is contemplated. A patient sensitive to iodine, if placed on a test dose consisting of 10 drops of a saturated solution of potassium iodide, will manifest enlargement of the salivary glands, or an urticarial eruption within three to four days.

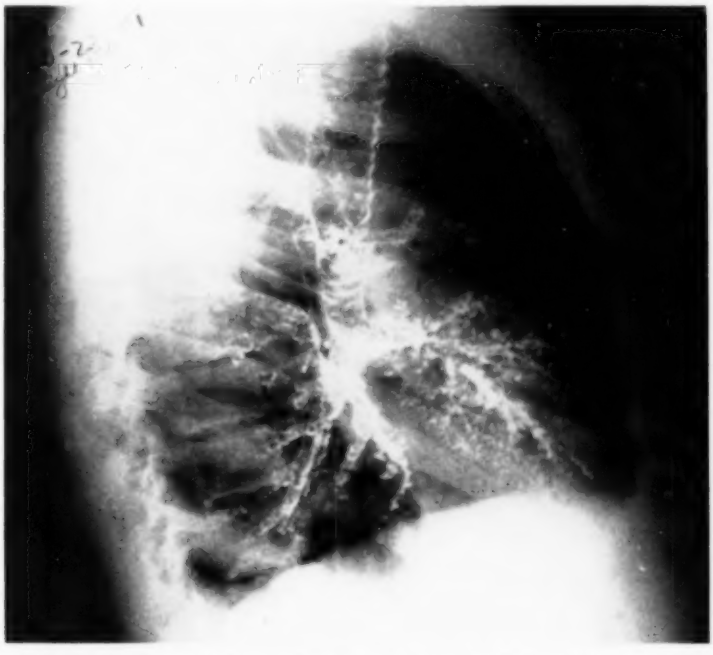

FIGURE 1B (October 26, 1951): Chest x-ray film. Right lateral view in case of T.E.B. Segmental distribution can be determined more easily in the lateral projection. The right middle lobe stands in relief. Saccular dilitation of all major bronchi are noted.

Absence of lipiodol in the smaller bronchi is due to inefficient "bellows" effect incident to the bronchiectasis, thus producing the "leafless tree."

P. Delie and P. Sourdat,[1] discussing the use of a water soluble iodine product, Diodone, for bronchography, point out its advantage in preventing iodism by virtue of "rapid resorption into the blood stream." Although a water soluble iodine product, a 50 per cent aqueous solution of Diodone (diiodopyridone acetate of diethaloamine) is available for bronchography.[1] This product has factors limiting its use, namely, its increased viscosity, its retarded penetration into the bronchi, hypertonicity, and hence its irritating quality producing cough to a greater extent than lipiodol. However, it is alleged that this drug is resorbed rapidly without producing iodism, a decided virtue. Nevertheless, because of its irritating quality, a bronchogram is impossible without adequate preparation of the patient which postulates perfect anaesthesia of the pharynx, larynx and bronchi. Furthermore, Diodone has less opacity than like quantities of lipiodol although it is averred that good images are obtained.

Because of the availability, ease of instillation and better contrast afforded by the iodized oils, such as lipiodol, it is doubtful if compounds

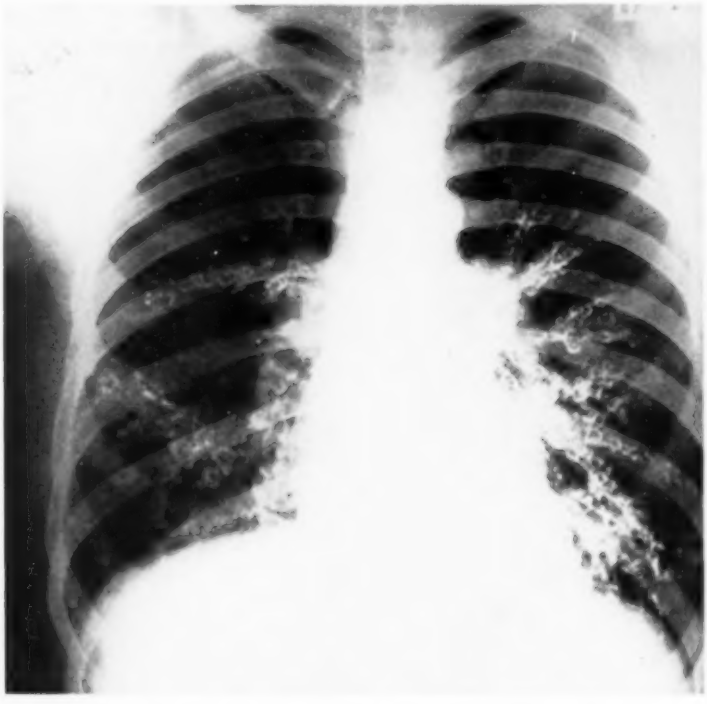

FIGURE 1C (November 1, 1951): Chest x-ray film. Postero-anterior view demonstrating the morbid condition on the left one week after the bronchogram on the right side was accomplished. Bronchial dilitation is present in all branches. In the PA view the heart shadow may block a significant area of the left lower lobe.

such as Diodone will replace them. It is apparent, therefore, that if ACTH or cortisone is effective in combating iodism, one of the great contraindications to bronchography, namely, that of instilling intrabronchial iodine in an iodine-sensitive patient, will have been eliminated.

Bronchography with iodized oil should be encouraged and practiced more frequently since in select cases it is one of the most rewarding of clinical procedures. This should be undertaken before any specific antibiotic therapy or chemotherapy is instituted, and in this way an early positive diagnosis may be arrived at and definitive pulmonary surgery may be employed to effect a permanent cure without undue delay. In this way palliative therapy is obviated, the possibility of drug sensitivity induced by aerosol medication is precluded, and the unfortunate instances of inadequate and dilatory medical therapy prevented which might otherwise carry the patient beyond the time for curative pulmonary surgery.

The instillation of iodized oil into the bronchial tree may be done by any of several methods: (1) Direct intratrachial injection with a curved canula. (2) Injection through a nasal catheter, the warmed oil running down the posterior and lateral pharyngeal walls into a pyriform sinus, and then spilling into the trachea of the patient seated in the inclined, upright position. (3) Intratrachial injection by the external approach between the cartilaginous tracheal rings, or through the cricothyroid ligament. (This procedure should be performed by experts, since faulty injection of lipiodol into tissues may result in cellulitis or gangrene, and in the latter approach the cords may be injured). (4) Instillation of the oil at the time of bronchoscopy. (5) The time-honored method of placing an intratrachial catheter after local anesthesia has been accomplished, controlling the lipiodol spread by positioning the patient under horizontal fluoroscopic guidance. The latter is the only way in which a complete filling of all segments of all lobes can be effected with assurance before roentgenograms are made. In order to insure a complete five lobe study only one side at a time is filled, and a week intervenes before the opposite side is visualized. On the initial study, after antero-posterior and lateral x-ray film views have been taken, postural drainage is required for 10 minutes before the patient is permitted to cough. In this way drainage of the pulmonary tree usually clears the lung of enough oil so that alveolar retention is no handicap to lateral x-ray films taken a week later when the opposite side is filled with oil. The left lateral view in this case, though obtained, is not available to us due to technical roentgenographic problems.

Most thoracic surgeons desire a complete five lobe study before attempting partial or total lobectomy or segmental surgery of the lung, as the amount and location of the involved lung tissue to be removed is definitely determined before any pulmonary surgery is contemplated. Extensive involvement of all lobes is a contraindication to surgical intervention. A bronchogram limited to one lobe or both lower lobes alone is not adequately informative and precludes the ability to predict the results which may be contemplated in the surgical treatment of bronchiectasis.

Comment

This procedure has great possibilities in the preparation of patients who have need for general diagnostic work where iodine preparations are employed. More recently we had the privilege of managing a patient with severe iodine sensitivity on whom cerebral angiography was contemplated, and this procedure was carried out successfully, using 40 cc. of Diodrast on two occasions at weekly intervals without any untoward effects. It may be stated that a year previously an anaphylactoid reaction occurred in this patient following the intravenous administration of 20 cc. of 35 per cent neo-iopax solution for intravenous urography. Heroic measures were required to combat this alarming medical emergency. Presently she is being prepared for intracranial surgery, and she has remained symptom free and without evidence of any delayed effects of iodine sensitivity. This case will be discussed in detail in a subsequent publication and is being included in this paper through the courtesy of Dr. Berget H. Blocksom and Dr. Clifford A. Allen.

It is obvious from the presentation of two interesting cases and the recent case report by Theodos[5] that ACTH has great value in diminishing the sensitivity of these patients thus preparing them for necessary diagnostic procedures wherein iodine containing material is employed and other materials cannot be substituted.

Because of the recent publication on the subject and the timeliness of it, we feel justified in presenting our one case in detail with a casual reference to angiography and urography so that this diagnostic and therapeutic adjuvant may be further explored by others in this field of endeavor, and that patients requiring this procedure may not be deprived of its use in the near future.

SUMMARY

1) A case study is presented wherein iodism was prevented by the use of a small intramuscular dose of ACTH prior to the intrabronchial instillation of iodized oil.

2) Signs and symptoms of iodism are discussed.

3) Various methods for bronchography are presented.

4) The importance of the bronchogram in chronic lung disease is emphasized.

5) Comment is made on the applicability of this procedure in other medical specialties where iodine preparations are employed in diagnostic procedures.

RESUMEN

1) Se presenta el estudio de un caso en el que el yodismo fué evitado por el uso de pequeñas dosis de ACTH intramuscular antes de la instilación intrabronquial del aceite yodado.

2) Se discuten los síntomas y signos del yodismo.

3) Se presentan varios procedimientos para la broncografía.

4) Se recalca la importancia del broncograma en las enfermedades pulmonares crónicas.

5) Se comenta la posibilidad de aplicar este procedimiento en otras especialidades médicas en las que las preparaciones yódicas son usadas para el diagnóstico.

RESUME

1) Les auteurs rapportent un cas pour lequel la prophylaxie de l'iodisme fut assurée par l'utilisation de petites doses d'A.C.T.H. par voie intra-musculaire, avant l'injection intrabronchique de lipiodol.

2) Ils mettent en discussion les signes et les symptômes de l'iodisme.

3) Ils présentent différentes méthodes de bronchographie.

4) Ils insistent sur l'importance de la bronchographie dans les cas d'affections pulmonaires chroniques.

5) Ils font quelques commentaires sur l'application de leur procédé prophylactique lorsque sont utilisés au point de vue diagnostique d'autres produits dans lesquels est contenue de l'iode.

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Evaluation of the Middlebrook-Dubos Hemagglutination Test in Tuberculosis*

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The hemagglutination test in the diagnosis of active tuberculosis has been the subject of considerable study since it was first described by Middlebrook and Dubos in 1948.[1] Because of conflicting reports by various workers, the value of the test as a diagnostic tool has not been clearly defined. The present study was undertaken for the purpose of investigating the sensitivity and the specificity of the reaction, and for the purpose of evaluating its capabilities as a method of assisting clinicians in the diagnosis of active tuberculosis.

Materials and Methods

Hemagglutination tests were performed on serum samples from 563 persons, of whom 72 had bacteriologically proved pulmonary tuberculosis, 257 had various non-tuberculous diseases, 80 were apparently healthy, and 54 were apparently healthy obstetrical and post-partum cases.

The method described by Middlebrook,[2] was employed for the performance of the tests. Special 4X old tuberculin† served as the antigen. Tests were read by two methods: first, by observing the shape of the button formed when the red cells settled to the bottom of the tubes, agglutination being indicated by a button of irregular shape or with serrated edges; and second, by shaking the tubes gently and observing for the presence of clumps which remained intact upon further gentle shaking. The titer of the serum was the highest dilution of serum which showed agglutination by either of the above methods. A test was considered to be positive if agglutination was present in a serum dilution of 1:8 or higher.

Tuberculosis cases were classified as minimal, moderately advanced, and far advanced in accordance with National Tuberculosis Association standards. None of the far advanced cases were terminal and nearly all of the cases studied had been treated with some type of chemotherapy.

In the case of the apparently healthy group, tuberculin skin tests were performed immediately following the withdrawal of blood for the hemagglutination test. In no case had a tuberculin test been performed within the three months preceding the hemagglutination test.

Active tuberculosis was ruled out clinically in all non-tuberculous cases which showed titers of 1:32 or higher.

*From the Research and Development Branch, Fitzsimons Army Hospital, Denver 8, Colorado.

†Provided through the courtesy of the Lederle Laboratories Division of American Cyanamid Company, New York, New York.

Results

Active tuberculosis (Table I): Positive titers were obtained with serum samples from 76 (66.3 per cent) of 122 tuberculosis cases studied. This group included 20 minimal, 53 moderately advanced, and 49 far advanced cases. Titers of 1:8 or higher were obtained with 30 per cent of the minimal cases, 66 per cent of the moderately advanced cases, and 71 per cent of the far advanced cases. The highest titer observed in the minimal disease group was 1:32.

Fifty additional tuberculosis patients were tested at monthly intervals for 11 months. In general, the hemagglutination titers remained rather constant and no correlation was observed between changes in titer and changes in the clinical condition of the patients.

Non-tuberculous disease (Table II): Serum samples from 257 hospital patients suffering from various non-tuberculous conditions were tested by the hemagglutination technique. Titers of 1:8 or higher were observed with 24.9 per cent of the total group. No correlation could be obtained between the incidence of false positive tests and any specific pathological condition. Titers of 1:128 were obtained from one case of chronic pneumonitis, one case of pulmonary fibrosis, and one case of inguinal abscess of unknown etiology. Titers of 1:256 and 1:512 were obtained with serum samples from patients with severe gunshot wound of the leg and meningococcic meningitis respectively.

Pregnancy and post-partum (Table III): Serum samples from 37 pregnant patients were tested by the hemagglutination method. Of these, 21 (57 per cent) agglutinated red cells in titers of 1:8 or higher. At 120 days post-partum, 12 of the above patients whose serum had been positive during pregnancy, were retested; two remained positive. Seventeen additional serum samples from patients at 10 days post-partum were tested and six (35 per cent) were positive.

Apparently healthy (Table IV): Hemagglutination tests were performed on serum samples from 30 tuberculin positive and 50 tuberculin negative soldiers who were apparently healthy at the time of testing. Hemagglutinins in serum dilutions of 1:8 or higher were observed in 24 per cent of the tuberculin negative, and in 23 per cent of the tuberculin positive cases.

Serum samples from 20 laboratory workers were subjected to the hemagglutination test at intervals of three to five months. Four members of this group converted from tuberculin negative to tuberculin positive during the period of observation, and as shown in Figure 1, all demonstrated marked increases in their hemagglutination titers. It would appear from the results observed with cases three and four, that these increases in titers followed the emergence of tuberculin sensitivity by a period of two to five months.

Discussion

The ideal sero-diagnostic test for tuberculosis should be one which would be sufficiently specific so that all cross reactions could be ruled out clinically. It should also be sufficiently sensitive so that a high percentage of active tuberculosis cases, in all stages of disease, would present positive

TABLE I

DISTRIBUTION OF HEMAGGLUTINATION TITERS FOR TUBERCULOSIS CASES GROUPED ACCORDING TO EXTENT OF DISEASE

	Total Cases	Negative No.	Pct.	1:2 No.	Pct.	1:4 No.	Pct.	1:8 No.	Pct.	1:16 No.	Pct.	1:32 No.	Pct.	1:64 No.	Pct.	1:128 No.	Pct.	1:256 No.	Pct.	1:512 No.	Pct.
Minimal	20	6	30.0	5	25.0	3	15.0	4	20.0			2	10.0								
Mod. Advanced	53	2	3.8	8	15.0	8	15.0	12	22.6	7	13.2	9	17.0	2	3.8	2	3.8	2	3.8	1	1.9
Far Advanced	49	2	4.1	6	12.2	6	12.7	9	18.4	13	26.5	6	12.2	4	8.2	1	2.0	1	2.0	1	2.0
TOTAL	122	10	8.2	19	15.6	17	13.9	25	20.5	20	16.4	17	13.9	6	4.9	3	2.4	3	2.4	2	1.6

TABLE II

DISTRIBUTION OF HEMAGGLUTINATION TITERS FOR NON-TUBERCULOSIS DISEASE CASES

	Total Cases	Negative No.	Pct.	1:2 No.	Pct.	1:4 No.	Pct.	1:8 No.	Pct.	1:16 No.	Pct.	1:32 No.	Pct.	1:64 No.	Pct.	1:128 No.	Pct.	1:256 No.	Pct.	1:512 No.	Pct.
Tumors Malignant	24	9	37.5	8	33.3	4	16.6	1	4.2			1	4.2			1	4.2				
Tumors, Benign	4	3	75.0			1	25.0														
Cardiac Hypertension	18	8	44.4	5	27.8	4	22.2	1	5.5												
Liver Disease	13	5	48.5	2	15.4	2	15.4	2	15.4	1	7.7	1	7.7								
Nephritis	10	3	30.0	1	10.0	2	20.0	3	30.0	1	10.0										
Non-Tuberc.* Pulmonary	36	10	27.7	11	30.5	6	16.6	5	13.8	1	2.8	1	2.8			2	5.5				
Acute Upper Respiratory	76	26	34.2	14	18.4	12	15.8	15	19.7	6	7.9	2	2.6	1	1.3						
Gastro-Intestinal	8	1	12.5	3	37.5	3	37.5	1	12.5												
Traumatic	27	4	14.8	11	40.7	6	22.2	2	7.4	2	7.4			1	3.7			1	3.7		
Rheumatic Disease	9	3	33.3	2	22.2	3	33.3	1	11.1												
Miscellaneous	32	11	34.4	5	15.6	6	18.7	6	18.7	2	6.2					1	3.1			1	3.1
TOTAL	257	83	32.3	62	24.1	48	18.8	38	14.8	13	5.1	5	1.9	2	0.8	4	1.5	1	0.4	1	0.4

*Bronchiectasis, Pneumothorax, Empyema, Bronchitis, Pneumonia, etc.

TABLE III

DISTRIBUTION OF HEMAGGLUTINATION TITERS FOR THE PREGNANCY AND POST PARTUM CASES STUDIED

	Total Cases	Negative No. Pct.	1:2 No. Pct.	1:4 No. Pct.	1:8 No. Pct.	1:16 No. Pct.	1:32 No. Pct.	1:64 No. Pct.	1:128 No. Pct.	1:256 No. Pct.	1:512 No. Pct.
Pregnant	37	3 8.1	5 13.5	8 21.6	12 32.4	3 8.1	2 5.4	2 5.4	2 5.4	0 0.0	
Post Partum 7-Days	17	6 35.3	1 5.9	4 23.5	3 17.6	1 5.9	2 11.8				
Post Partum 120-Days	12	2 16.7	4 33.3	4 33.3	1 8.3	0 0.0	1 8.3				

TABLE IV

DISTRIBUTION OF HEMAGGLUTINATION TITERS FOR NORMAL CASES

(Bases on Tuberculin Sensitivity 1st and 2nd Strengths)

	Total Cases	Negative No. Pct.	1:2 No. Pct.	1:4 No. Pct.	1:8 No. Pct.	1:16 No. Pct.	1:32 No. Pct.	1:64 No. Pct.	1:128 No. Pct.	1:256 No. Pct.	1:512 No. Pct.
Mantoux Negative	50	16 32.0	8 16.0	14 28.0	7 14.0	2 4.0	3 6.0				
Mantoux Positive	30	11 36.9	7 23.3	5 16.7	5 16.7	2 6.7					
TOTAL	80	27 33.7	15 18.7	19 23.7	12 15.0	4 5.0	3 3.7				

titers. As performed in this laboratory, the hemagglutination test met neither of these criteria with enough consistency to warrant its use as a routine diagnostic tool.

The lack of sensitivity in the test was especially apparent in the case of the minimal tuberculosis group wherein only six of the 20 cases tested presented titers of 1:8 or higher; the highest titers observed being 1:32. Such a finding would appear to be unfortunate since it is at this stage of tuberculosis that a sero-diagnostic test would be of most value.

A definite cross reaction occurred when the hemagglutination test was applied to serum samples from non-tuberculous women in late pregnancy. That the cross reaction was of a transient nature was indicated by the decrease in the percentage of positive reactors following parturition.

No definite cross reaction could be correlated with any specific non-tuberculous disease, and it was interesting to note that the only significant difference observed between the results obtained with the non-tuberculous disease group and the apparently healthy group, was that higher titers were obtained in the former. No significant differences were believed to exist between the results obtained with the tuberculin positive and tuberculin negative members of the apparently healthy group.

The hemagglutination test appeared to be of little value for the prognosis of tuberculous disease since no correlation was observed between clinical changes in the patients disease picture and changes in hemagglutination titers.

Of definite importance in evaluating the specificity and the sensitivity of the hemagglutination reaction, is the method employed for reading the

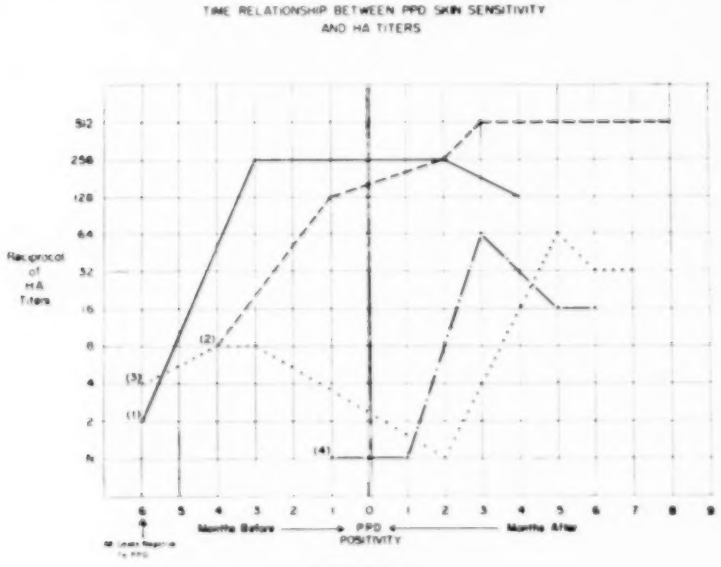


FIGURE 1

tests. Three methods were investigated for this work. The first consisted of observing the shape of the button formed when the red cells settled to the bottom of the tubes. This method usually, but not always produced the lowest titers and was the most specific; however, it lacked sensitivity to the extent that the percentage of positive reactors among tuberculosis cases was very low. The second method consisted of shaking the tubes gently in an upright position and observing for the presence of clumps of red cells which remained intact upon further gentle shaking. This method generally produced higher titers than the first method and consequently was more sensitive but less specific. The third method studied was to snap the tubes vigorously two times with the finger and observe for the presence of clumping over a mirror; results being recorded as one plus, two plus, three plus, and four plus depending on the amount of clumping observed. This method produced the highest titers and was therefore the most sensitive; its use however, resulted in a great loss in specificity. The results reported in this paper were based upon the highest titer obtained from a combination of the first and second methods. It should be pointed out that the titers obtained with the three different methods did not always follow the order of sensitivity as presented above, since in some sera, the highest titers were obtained with the first method of reading.

SUMMARY

The Middlebrook-Dubos hemagglutination test for the diagnosis of tuberculosis was performed on serum samples from 172 patients with active tuberculosis, 257 patients with various non-tuberculous diseases, 54 apparently healthy obstetrical and post-partum cases, and 80 apparently healthy individuals.

1) As performed in this laboratory, the hemagglutination test was neither sufficiently specific nor sufficiently sensitive to warrant its use as a routine diagnostic tool.

2) A definite cross reaction of transient nature was observed with pregnancy.

3) False positive reactions were obtained with approximately one fourth of the serum samples from patients with non-tuberculous disease and persons who were apparently healthy at the time of testing.

4) Only 30 per cent of the cases of minimal tuberculosis studied presented titers in the positive range.

5) The test appeared to be of little prognostic value.

6) Increases in serum hemagglutinins in apparently healthy laboratory workers were apparent two to five months after the individual demonstrated sensitivity to tuberculin.

RESUMEN

La prueba Middlebrook-Dubos de hemoaglutinación para el diagnóstico de la tuberculosis fué llevada a cabo en muestras de serosidad de 172 pacientes con tuberculosis activa, 257 pacientes con várias enfermedades

no-tuberculosas, 54 aparentemente saludables embarazadas y casos post-partum y ochenta individuos aparentemente saludables.

1) De la manera llevada a cabo en este laboratorio la prueba de hemoaglutinación no demostró ser suficientemente especifica ni suficientemente sensitiva para garantizar su uso como método de trabajo rutinario.

2) Una reacción cruzada de naturaleza transitoria fué observada con las embarazadas.

3) Reacciones positivas falsas fueron obtenidas con aproximádamente un cuarto de las muestras de los pacientes con enfermedades no tuberculosas y personas que aparentemente estaban saludables en la época de la prueba.

4) Solo un 30 por ciento de tuberculosis mínima tiende hacia el campo positivo.

5) La prueba demostró ser de poco valor para pronóstico.

6) Aumentos de hemaglutininas séricas en trabajadoras de laboratorio aparentemente saludables aparecieron de dos a cinco meses después de la sensibilidad individual demostrada a la tuberculina.

RESUME

L'épreuve d'hémagglutination de Middlebrook-Dubos pour le diagnostic de la tuberculose a été expérimenté sur le sérum de 172 malades, atteints de tuberculose évolutive, 257 porteurs d'affections diverses non tuberculeuses, 54 apparemment sains (femmes enceintes ou venant d'accoucher) et 80 individus en bonne santé apparente.

1) Selon les constatations faites dans le laboratorie des auteurs, l'épreuve d'hémagglutination ne s'est montrée ni suffisamment spécifique, ni suffisamment sensible pour donner une garantie comme moyen diagnostique de routine.

2) Une réaction croisée certaine, de nature transitoire, fut observée au cours de la grossesse.

3) Des réactions faussement positives furent obtenues chez approximativement un quart des malades atteints d'affections non tuberculeuses, et des individus apparemment sains.

4) Il n'y a que 30% des malades atteints de tuberculose discrète qui donnèrent lieu à des réactions positives.

5) L'épreuve se montra de peu de valeur au point de vue du pronostic.

6) Les auteurs ont constaté une augmentation des agglutinines du sérum chez le personnel du laboratoire apparemment sain, de deux à cinq mois après l'apparition de l'allergie tuberculinique.

REFERENCES

1 Middlebrook, G. and Dubos, R. J.: "Specific Serum Agglutination of Erythrocytes Sensitized with Extracts of Tubercle Bacilli," *Jour. Exper. Med.*, 88:521, 1948.

2 Middlebrook, G.: "Technique for Performing the Hemagglutination Test for Tuberculosis," Communication to the Streptomycin Committee, Veterans Administration, June 2, 1950.

Retiring President's Address*

ANDREW L. BANYAI, M.D., F.C.C.P.
Milwaukee, Wisconsin

Nearly twenty years have gone by since, from the intuitive imagination of a few interested individuals, the American College of Chest Physicians was born.

From the time when the idea of a new, different, progressive and dynamic scientific body materialized, metaphorically speaking, this organization has developed into a giant tree, the branches of which today reach all over the world, to be exact, into 70 countries. As a result, the American College of Chest Physicians is an international society.

Since its early days, this organization has become a symbol of modern scientific endeavor, an inexhaustible fountainhead of pertinent information, a catalyst of international good will and a permanent repository of new discoveries in its particular field.

*Convocation, 19th Annual Meeting, American College of Chest Physicians, New York City, May 30, 1953.

The Presidential Scroll being presented to the outgoing President, Dr. Andrew L. Banyai (right) by Major General S. U. Marietta, MC, USA (retired), Washington, D. C., Past President, at the President's Banquet, Hotel New Yorker, Saturday, May 30, 1953.

Its official medical journal, *Diseases of the Chest*, is highly regarded by all concerned and it is eagerly sought after as a medium for publishing articles from leading medical centers, clinical groups and by physicians who devote some of their time and efforts to the development of new methods in the diagnosis and treatment of chest diseases.

The headquarters of the College, a beautiful, modernistic building, only a few steps from Chicago's fabulous Michigan Boulevard, is a focal point to which doctors interested in our specialty come in person or contact it through correspondence from all parts of the world so as to get the benefit of its vast perspective.

This new structure is, figuratively as well as actually, a concrete monument to the remarkable past of this organization. At the same time, it is a phenomenally busy and sedulous center of the constructive activities of the Executive Offices, the various Councils and Committees of the College.

The new building of the College is the home of such endeavors as carried out ceaselessly by Fellows of the College, concerning undergraduate and postgraduate medical education, cardiovascular diseases, bronchoesophagology, public health, chemotherapy of chest diseases, and several other items of great merit and current interest.

The Council on Research deserves special mention in this connection, for it is expressive of one of the fundamental purposes of the College. Through the moral and material support of this Council, the College aims at inspiring men of inquisitive mind to find new pathways to improved diagnosis and treatment of chest diseases.

You have come here today on this festive occasion, as a telling proof of your genuine interest in the affairs of this organization. To the officers and Fellows of the College who unselfishly and faithfully have been devoting their labor to the advancement of the College, it is a gratifying and unforgettable event to see you and greet you on this memorable occasion.

We have gathered here today to pay tribute to the men who took it upon themselves to build this organization into a scientific body second to none; also, we are here today to receive into our midst those whose ambition and professional attainments prompted them to join hands with us within its domain.

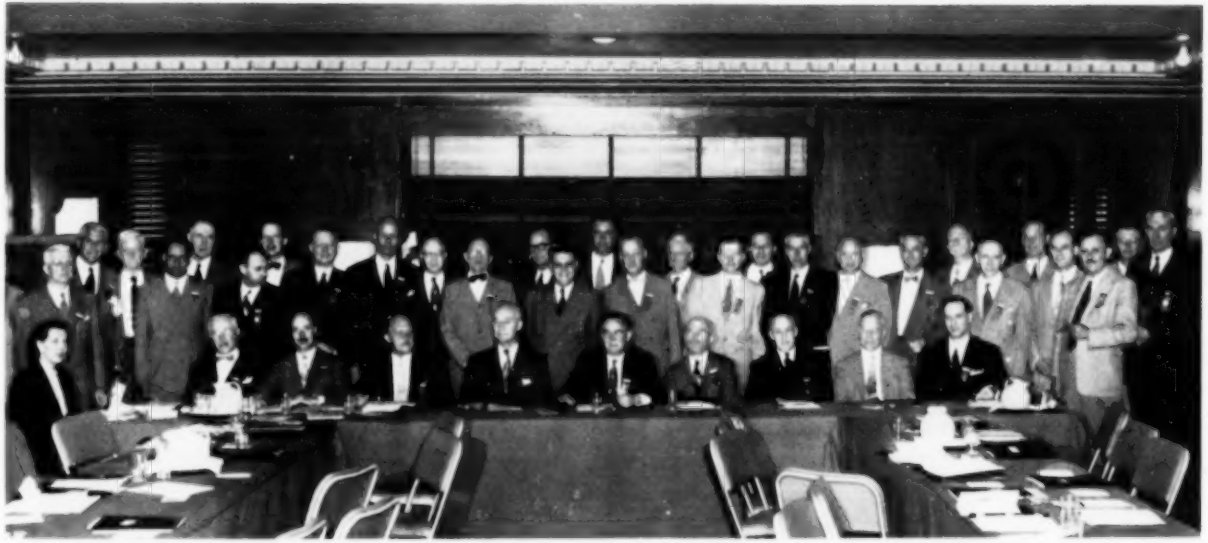
It is with utmost pride and with genuine satisfaction that we can point to the roster of the College. This roster includes names of winners of the Nobel Prize, of teachers of medicine and surgery of world-renown and names of famous research workers. It reads like an exclusive Who's Who in Medical Science.

To the men and women who from now on will be officially added to this roster, the names of this distinguished group of celebrities should serve as a potent incentive and inspiration. May their great accomplishments and the record of their outstanding pioneering work imbue each and every one of you with new interest, new purpose and new enthusiasm.

If I am a true prophet—as I can see it with my mind's eye—your association with and your participation in the activities of the American College of Chest Physicians are bound to bring about still greater achievements in the chronicles of the College and in the progress of medical science.

It is my ardent wish and desire that in the spirit of the American College of Chest Physicians, no matter where you are, your motto be: The welfare of the patient above everything else.

ANNUAL MEETING, BOARD OF REGENTS



The Board of Regents of the American College of Chest Physicians meeting in annual session at the Hotel New Yorker, New York City, Thursday, May 28, 1953.

Board of Regents Meeting

The annual meeting of the Board of Regents of the American College of Chest Physicians was held at the Hotel New Yorker, New York City, on Thursday, May 28, 1953. A second meeting of the Board was held at the Hotel New Yorker on Sunday, May 31. The following members of the Board, committee chairmen and guests were present:

Donald R. McKay, Buffalo, New York, Chairman
Donato G. Alarcon, Mexico City, Mexico
Robert J. Anderson, Washington, D. C.
Russell S. Anderson, Erie, Pennsylvania
Albert H. Andrews, Jr., Chicago, Illinois
Carl C. Aven, Atlanta, Georgia
Andrew L. Banyai, Milwaukee, Wisconsin
Otto L. Bettag, Chicago, Illinois
John F. Briggs, St. Paul, Minnesota
Dean B. Cole, Richmond, Virginia
Seymour M. Farber, San Francisco, California
M. Jay Flipse, Miami, Florida
Louis L. Friedman, Birmingham, Alabama
Carl H. Gellenthien, Valmora, New Mexico
Alfred Goldman, St. Louis, Missouri
Alfred N. Goldman, Beverly Hills, California
Burgess L. Gordon, Philadelphia, Pennsylvania
Edward A. Greco, Portland, Maine
Edward W. Hayes, Monrovia, California
Hugh L. Houston, Murray, Kentucky
Willard B. Howes, Detroit, Michigan
William A. Hudson, Detroit, Michigan
Hollis E. Johnson, Nashville, Tennessee
Harold I. Kinsey, Toronto, Canada
Aldo A. Luisada, Chicago, Illinois
S. U. Marietta, Washington, D. C.
Louis Mark, Columbus, Ohio
Edgar Mayer, New York, New York
Herman J. Moersch, Rochester, Minnesota
Jay Arthur Myers, Minneapolis, Minnesota
Theodore H. Noehren, Buffalo, New York
William E. Ogden, Toronto, Canada
Arthur M. Olsen, Rochester, Minnesota
Richard H. Overholt, Brookline, Massachusetts
J. Winthrop Peabody, Washington, D. C.
Charles K. Petter, Waukegan, Illinois
Joseph C. Placak, Cleveland, Ohio
William R. Rumel, Salt Lake City, Utah
James H. Stygall, Indianapolis, Indiana
Raman Viswanathan, New Delhi, India
David H. Waterman, Knoxville, Tennessee
Executive Staff: Murray Kornfeld, Executive Director
Harriet L. Kruse
Margaret Rogers
Samuel N. Turiel.

The first meeting of the Board was called to order by the Chairman at 2:00 p. m. The following report of the Treasurer was read by Dr. Petter and accepted upon motion made and seconded:

STATEMENT OF INCOME AND EXPENSES FOR THE YEAR ENDED DECEMBER 31, 1952

INCOME:		
Annual Dues		$69,706.60
Fellowship Fees		21,018.03
Sales:		
Advertising	$28,471.69	

Subscriptions	18,969.73		
Exhibit Space	925.00		
Fellowship Keys	332.09		
Medical Book Service	93.64		
	$48,792.15		
Less—Discount Allowed	4,948.71	43,843.44	
Interest Received on U. S. Savings Bonds		832.50	
Post Graduate Council		3,705.42	
TOTAL INCOME			$139,105.99
EXPENSES:			
Salaries		$38,675.80	
Printing Journal		35,877.22	
Directory Expense		12,221.62	
Annual Meeting		5,557.54	
International Meeting		3,585.94	
Building Account		5,679.09	
Printing and Engraving		3,267.11	
Handling and Posting Journal		4,236.06	
Postage and Shipping		3,153.74	
Officers' and Committee Expense		2,650.27	
Telephone and Telegraph		1,643.20	
Office Expense		1,239.44	
Traveling—Executive Secretary		1,156.91	
Semi-Annual Meeting—Board of Regents		630.66	
Public Relations Expense		1,277.42	
Editor of Journal		1,400.00	
Library Expense		126.08	
Membership Certificates		582.86	
Payroll Taxes		410.49	
Employment Agency Fees		645.00	
Secretary to Chairman—Board of Regents		125.00	
President's Secretarial Expense		275.00	
Prize Essay Award		250.00	
Audit		225.00	
Contribution to World Medical Association		500.00	
College Medal		102.50	
Contribution to Natl. Soc. for Med. Research		25.00	
Depreciation—Furniture and Fixtures		723.70	
TOTAL EXPENSES			$126,242.65
NET INCOME			$ 12,863.34

1952 audit prepared by Ralph Marcus, C.P.A., Chicago, Illinois.

The report of the Committee on Scientific Program was presented by the Chairman, Dr. Olsen. Dr. Olsen and his committee were congratulated upon the excellence of the program which had been arranged.

The report of the Committee on General Arrangements for the 19th Annual Meeting of the College was received and Dr. Mayer and the members of his committee were complimented for their splendid work.

Dr. Peabody, Chairman of the Council on Postgraduate Medical Education presented the following report:

POSTGRADUATE COURSE ENROLLMENTS

City	1948	1949	1950	1951	1952	1953
Chicago	44	38	51	51	65	Sept. 28-Oct. 2
Milwaukee	—	—	—	68	41	59
Nashville	—	—	—	50	—	—
Newark	—	—	—	—	85	—
New York City	76	86	110	138	97	Nov. 2-6
Philadelphia	62	44	47	54	87	68
San Francisco	43	71	—	36	43	—

Postgraduate courses have been given by College Chapters in the following countries during the period 1951 to the present date: Havana, Cuba, 1951 and 1952; Manila, P. I., 1951; Lima, Peru, 1953.

The American College of Chest Physicians cooperated with medical schools and medical societies in presenting courses in the following cities during 1951-1953: Denver, Colorado; Houston, Texas; Los Angeles, California; Minneapolis, Minnesota; Portland, Oregon; and Salt Lake City, Utah.

Dr. Peabody announced plans for future postgraduate courses sponsored by the Council on Postgraduate Medical Education of the College and reiterated that the Board of Regents had ruled, upon recommendation of the Council, that postgraduate courses must be self-supporting and that no travel expenses, honoraria or per diem could be paid by the College for lecturers. Dr. Alarcon stated that plans for a postgraduate course in Mexico City to be sponsored by the College Chapter there had been initiated and requested the help of the College in obtaining speakers for the course. He explained that it was planned to ask fees for the course, but that they would not be able to pay the travel expenses of speakers from the United States. However, Dr. Alarcon pointed out that they will be able to take care of hotel expenses in Mexico City for well known members of the College who would be invited to lecture at the course. Motion was made and seconded that the Board of Regents instruct the Council on Postgraduate Medical Education to collaborate with Dr. Alarcon in exploring the feasibility of a postgraduate course. Dr. Viswanathan suggested that the motion be amended to read "explore the feasibility of arranging postgraduate courses in other countries." Motion was made and seconded to amend the previously accepted motion.

Dr. Overholt recommended that the College cooperate with the World Health Organization and the Unitarian Service Commission (Boston) in arranging to send lecturers to other countries. Mr. Kornfeld stated that the College had official relations with the World Health Organization through its Non-Governmental Organizations Committee, as well as with the World Medical Association as a member organization of its United States Committee.

The report of the Committee on Cardiovascular Diseases was presented by Dr. Briggs, Chairman. The committee recommended that physicians engaged in the management and treatment of peripheral heart disease be permitted to apply for membership in the American College of Chest Physicians. In addition, recommendation was made to permit admittance of radio therapists to membership in the College. Upon motion duly made and seconded, this matter was referred to the Executive Council for consideration.

The report of the Committee on Motion Pictures was presented by Dr. Waterman. Motion was made and seconded to accept the recommendation of the committee to change the name to "Committee on Audiovisual Aids." Dr. Waterman pointed out that a list of the films covering various aspects of the diagnosis and treatment of diseases of the chest had been approved by the committee and had been published in the College journal, *Diseases of the Chest*, and that reprints were available for distribution to those interested.

The following report of the Committee on Membership was read by Dr. Flipse:

On June 1, 1952, we reported a total membership of 4,016. Today we are reporting a total membership of 4,441, an increase of 425 for the year. Of these 4,411 members, 3,039 are Fellows, 341 are Associate Fellows, 999 are Associate Members, 54 are Fellows Emeritus and 8 are Honorary Fellows. In Canada and the United States, we have 2,894 members and in all other countries we have 1,547. Our membership is now distributed through 76 countries and territories. In addition to the above members, as of May 15, 1953, we had a total of 107 applications pending approval by the Board of Regents. Of this total, 65 are for Fellowship, 18 for Associate Fellowship, 18 for Associate Membership and 6 for Advancement to Fellowship. These applications will be presented to the Board of Regents for consideration at the semi-annual meeting.

Dr. Myers, Editor-in-Chief, presented the report of the Editorial Board for the College journal, *Diseases of the Chest*. The Board recommended the re-election of Dr. Henry C. Sweany, Tampa, Florida, as a member of the Editorial Board for a term of three years. Motion was made and seconded to accept the report and approve the election of Dr. Sweany.

Dr. Bettag reported that the Committee on Chest X-Ray, which is a joint committee with the American College of Radiology, would meet on Tuesday, June 2. At this subsequent meeting the committee discussed the valuable contributions in the field of radiology of Professor Manoel de Abreu, Rio de Janeiro, Brazil, and unanimously voted that a letter of appreciation be prepared and sent to him as a joint expression of the members of the committees and their respective societies. It was recommended that the committee devote attention to the organization of a follow-up system for x-ray surveys; however, it was agreed that this matter would be discussed further at the next meeting of the committee. In the interim, it was resolved that the report of the Joint Committee, which was published in the May, 1953 issue of *Diseases of the Chest*, be disseminated further and that the state medical societies be contacted with regard to its publication in their respective journals. The matter of protection was discussed briefly. The committee agreed that 300 milliroentgens is the standard and should be the standard, and that any statement of the committee had to do with operating procedures rather than with protection.

Dr. R. J. Anderson presented the reports of the International Committee on BCG and the Council on Public Health. The International Committee on BCG has requested of the Board of Regents that sufficient time be provided in the program at the III International Congress on Diseases of the Chest for an open forum for the exchange of scientific information and program data relative to BCG and other vaccines for tuberculosis, and that there be designated a forum leader, assistants, and a recording secretary (multi-lingual if possible) to prepare a summary of the forum. It was the Chairman's understanding that the International Committee desires the time not be divided for formal papers but be unscheduled to facilitate discussion around various facets of vaccination for tuberculosis. Upon motion duly made and seconded the above recommendations were accepted.

The Chairman reported that the Council on Public Health has been considering the ways in which it can further the objectives of the College "to promote the public welfare in connection with the specialty of diseases of the chest." The mechanism that seems most adaptable to do this is the existence of the many chapters and the many state tuberculosis committees. What is needed is an aggressive program that the College and its chapters, the tuberculosis committees of state and local medical societies can undertake according to their local desire. Two special problems will require some discussion. They are (1) the treatment and management of the unhospitalized tuberculous patient from the public health aspects, and (2) the use and abuse of narcotics by physicians in the treatment of diseases of the chest. Motion was made and seconded that the report of the Council be accepted.

It was reported that the College Medal would be awarded to Dr. Helen Taussig

for meritorious achievement in diseases of the chest and that the presentation would be made at the Presidents' Banquet on Saturday evening, May 30. Dr. Houston reported that the Committee on College Essay was pleased to announce the winner of the essay contest as Dr. A. Link Koven, a resident at the Graduate Hospital, University of Pennsylvania, Philadelphia. A certificate of award and a cash prize of $250.00 would be presented to Dr. Koven at the Presidents' Banquet on May 30.

Dr. Mayer, Medical Advisor to the Board of the Will Rogers Memorial Hospital, Saranac Lake, New York, announced that an annual Achievement Awards Program was to be initiated by the hospital as a stimulus in fighting tuberculosis and other chest diseases. He stated that the hospital Board had suggested the first presentation of the annual awards be made at the 1954 Annual Meeting of the American College of Chest Physicians and that the nominees be selected by the College shortly after January 1, 1954. It had been further suggested that a committee of judges representing the College, the American Medical Association, and the Medical Staff of the Will Rogers Hospital, determine the individuals eligible for the awards for the year 1953. Those who, in the judges' opinion, have made the greatest discovery in research, the most important medical contribution, and the highest achievement in surgery of chest diseases will be honored individually each year. Sculptured bronze plaques and cash honorarium will be awarded in each of the three fields. The matter was referred to the Committee on College Awards for consideration and upon its recommendation, was approved by the Board of Regents.

Meeting adjourned.

The second meeting of the Board of Regents was called to order by the Chairman at 4:00 p. m. on Sunday, May 31, 1953. Dr. Hayes, Chairman of the Council on Undergraduate Medical Education, presented his report and Dr. Noehren, Vice-Chairman of the Council, read the following resolution:

WHEREAS, the Council on International Affairs of the American College of Chest Physicians is concerned with the teaching of chest diseases in medical schools throughout the world, and

WHEREAS, there are 4,500 Fellows and Associate Members of the American College of Chest Physicians residing in 76 countries and territories throughout the world, and

WHEREAS, most of the members of the American College of Chest Physicians are concerned with the teaching of chest diseases in the medical schools, and

WHEREAS, the specialty of diseases of the chest is an inter-related specialty which requires the cooperation of the physician and the surgeon, and

WHEREAS, it is essential in the diagnosis and treatment of heart and lung diseases that there be cooperation and teamwork between the clinician, thoracic surgeon and bronchoscopist,

THEREFORE BE IT RESOLVED, that medical faculties of universities and of teaching institutions be requested to establish *Departments of Chest Diseases* for the purpose of imparting adequate training to undergraduate students in this important specialty.

Motion was made and seconded to accept the report and resolution and it was unanimously agreed that the resolution be presented to the World Health Assembly at their World Conference on Medical Education being held in London, August 22-29, 1953. Dr. Viswanathan, Regent of the College for India and a delegate to the World Health Assembly, was appointed to present the resolution.

Upon the recommendation of the Committee on College Essay, the motion was made and seconded that the essay contest for the coming year be limited to medical students studying for the degree of Doctor of Medicine.

The report of the Council on Hospitals was presented by the Chairman, Dr. R. S. Anderson. The Council made the following recommendations:

1) That a council or committee member be appointed as a liaison representative to the Council on Professional Practices of the American Hospital Association

whose representatives will survey the majority of tuberculosis institutions under the new Joint Commission on Accreditation. Dr. I. D. Bobrowitz, Otisville, New York, was recommended for appointment.

2) The recent death of Dr. Loren L. Collins, Chairman of the Committee on Hospital Statistics, was announced and the Council Chairman requested to send Mrs. Collins suitable expressions of condolence and sympathy. A new chairman of the committee to be appointed.

3) That the membership of the Council on Hospitals be limited to all committee chairmen, a member of the Board of Regents, and, in addition, only three non-committee members of which one shall be designated as Chairman, one as Vice-Chairman and one as Secretary. That present Council members be permitted to complete their current terms of office.

4) That the recommendation submitted by the Council one year ago be re-considered by the Board of Regents, i.e., that the Committee on Sanatorium Standards henceforth be known as the Committee on Standards and Accreditation.

5) That the Board of Regents investigate the situation with regard to the use of the minimum standards for tuberculosis hospitals prepared and adopted by the College and adopted by the American College of Surgeons.

Motion was made and seconded to accept the report of the Council on Hospitals, as well as the recommendations, and an expression of appreciation was made to Dr. Anderson for the fine work of his Council and committees. The Board also complimented them upon the preparation and publication of *The Hospital Counselor*.

In the absence of the chairman of the Committee on Resident Fellowships, Dr. Alfred Richman, the Executive Director reported that after two years of activity the Committee has raised seven thousand dollars from various sources. An additional sum of one thousand dollars had just been contributed by a patient. At the present time, he stated, there were nine resident fellows in the United States and that over 100 applications had been received from doctors all over the world. Motion was made and seconded to accept the report.

Dr. Hudson, Chairman of the Board of Examiners, announced that 90 candidates for Fellowship in the College had taken their oral and written examinations on Thursday, May 28.

Motion was made and seconded that Dr. Banyai be elected to serve on the Committee on Nominations for the year 1953-1954.

Motion was made and seconded that Dr. Farber be re-elected Regent-at-Large to the Executive Council.

Motion was made and seconded that Dr. McKay be re-elected as Chairman of the Board of Regents.

The following resolutions were read and accepted:

WHEREAS, the New York State Chapter of the American College of Chest Physicians has successfully established a Howard Lilienthal Lecture, and

WHEREAS, many other Chapter officials have indicated that they would be interested in establishing similar lectures to be presented at the annual meetings of their Chapters, and

WHEREAS, these lectures tend to attract prominent speakers and assist the Chapters in obtaining larger attendances at their annual meetings, and

WHEREAS, these lectures make it possible to bestow an honor on some worthy scientist who has made a contribution to the specialty of diseases of the chest, and

WHEREAS, a certificate is issued to the physician who is invited to deliver this special lecture,

THEREFORE BE IT RESOLVED, that the Board of Regents of the College encourage the Chapters to establish special lectures to be presented in connection with their annual meetings, and

BE IT FURTHER RESOLVED, that the lecture be presented in the name of a prominent scientist who is acceptable to the officials and members of the Chapter.

WHEREAS, the Board of Regents of the American College of Chest Physicians has authorized the establishment of a Committee on Resident Fellowships in Chest Diseases, and

WHEREAS, this Committee has been functioning for the past two years, and

WHEREAS, a number of physicians from other countries are studying under the sponsorship of the committee in the United States, and

WHEREAS, several Resident Fellows have completed their training and have returned to their respective countries, and

WHEREAS, it is customary procedure to award certificates of recognition to such physicians who have completed their Resident Fellowship,

THEREFORE BE IT RESOLVED, that the Board of Regents of the American College of Chest Physicians authorize the Committee on Resident Fellowships in Chest Diseases to prepare a suitable certificate for awarding to such physicians who, in the opinion of the committee and upon receipt of a statement from the institution, have successfully complied with the rules and regulations for Resident Fellowship in Chest Diseases.

The Executive Director announced that the registration for the 19th Annual Meeting of the College reached a total of almost 1,500 and that this was the largest registration ever attained at a College meeting.

Announcement was made that the interim session would be held at the Park Plaza Hotel, St. Louis, Missouri, November 29 and 30, 1953. Dr. Alfred Goldman, Regent of the College for the District, was appointed by the President to serve as Chairman of the Committee on Arrangements for the meeting. Dr. Goldman stated that he would welcome suggestions for the program to be presented in St. Louis.

Announcement was made that the 20th Annual Meeting of the College would be held in San Francisco, California, June 17 through 20, 1954. Dr. Seymour M. Farber, Regent of the College for California, was appointed by the President to serve as Chairman of the Committee on General Arrangements for the next annual meeting of the College. The President appointed Dr. Edgar Mayer, New York City, to serve as Chairman of the Committee on Scientific Program for the 1954 meeting.

Meeting adjourned.

Report of the Historian

Mr. President, members of the American College of Chest Physicians, friends and guests:

This occasion is a solemn one, and it leaves us with a kind of vacuum and a real sadness. May we say in the words of Robert G. Ingersoll who wrote, "Another year has joined his shadowy fellows in the wide and voiceless desert of the past, where, from the eternal hour glass forever falls the sands of time. Another year with all its joy and grief, of birth and death, of failure and success, of love and hate."

On this day we pause to pay special honor and final tribute to those of our members who, during the past year, have laid down their earthly duties and have passed on to their eternal reward. Each of these members have no doubt been properly and individually eulogized on the occasion of his passing by their respective chapters or medical societies. But several of our deceased members were better known to most of us than others, therefore, a few words to freshen our memories would not be amiss.

Doctor Minas Joannides, Treasurer of the College at the time of his death, was a renowned physician, a teacher, a fine citizen, and for many years a faithful servant of this college. His contributions in time and service were too many to enumerate.

Doctor Nelson Strohm, one of our early members, served as President of the New York State Chapter of the College in 1941 as well as Regent for District 2 (New York State).

Doctor Paul H. Ringer was a former Regent and Past President of the Southern

Chapter of the College. He had held many honors in other medical societies.

Doctor Carl Schaefer was Governor for Wisconsin and President of the Wisconsin Chapter.

Doctor Loren L. Collins had served the College with distinction as Chairman of the Committee on Hospital Statistics.

DECEASED MEMBERS

David Harvey Cohen	***Flushing, Long Island***
Loren L. Collins	***Edwardsville, Illinois***
George W. Cragg	***Cornwell, Ontario, Canada***
J. Dwight Davis	***Long Beach, California***
Henry Lathrop Dyer	***Gorham, New Hampshire***
Gerald A. Ezekiel	***Richmond, Virginia***
Albert Henry Garvin	***Buffalo, New York***
Raymond Ernest Goeway	***Berea, Ohio***
Sidney I. Goldberg	***New York, New York***
Minas Joannides	***Chicago, Illinois***
Bert Donald Krug	***Dayton, Ohio***
Arthur Jones Logie	***Miami, Florida***
Arthur D. Long	***El Paso, Texas***
Kronid Melenko	***New York, New York***
Lee Ogden	***New York, New York***
Andrew Nady	***Fort Bayard, New Mexico***
Charles McCormick Oberschmidt	***Memphis, Tennessee***
Paul E. Pifer	***Kenosha, Wisconsin***
Maxim Pollak	***Memphis, Tennessee***
Harry Floyd Rapp	***Portsmouth, Ohio***
Paul H. Ringer	***New York, New York (Formerly of Asheville, N. C.)***
Carl Schaefer	***Racine, Wisconsin***
Martin August Schupmann	***Chicago, Illinois***
Nelson W. Strohm	***Buffalo, New York***
Jacob Jesse Wiener	***New York, New York***
Louis Henry Wettlaufer	***Fort San, Saskatchewan, Canada***

As we, who are left behind, assemble here to pay our former fellows honor, we should pledge renewed efforts in our service to each other and to mankind. In our friendships let us not with the words of George W. Childs, "Keep the alabaster box of our love and tenderness sealed up until our friends are dead." To these living friends let us say the kind things we meant to say before they are gone.

Let us remember that this kind of friendship is the shadow of the evening that strengthens with the setting sun of life. Let us each bid for that kind of friendship that Clarendon describes in these words, "Friendship hath the skill and observation of the best physician, the diligence and vigilance of the best nurse, and the tenderness and patience of the best mother."

Carl C. Aven, Historian.

ANNOUNCEMENT

The 10th Congress of the Union of Latin American Societies Against Tuberculosis (ULAST), under the Presidency of Dr. Jose Ignacio Baldo, F.C.C.P., will be held in Caracas, Venezuela, December 5-10, 1953. Dr. Fernando D. Gomez, F.C.C.P., of Montevideo, Uruguay, Secretary-General of the Union, requests that all physicians who wish to participate in the scientific program send brief abstracts of their presentations to Doctor Jose Ignacio Baldo, Sanatorio Simon Bolivar, El Algodonal, Caracas, Venezuela. Copies of correspondence should be forwarded to the Executive Director of the American College of Chest Physicians, 112 East Chestnut Street, Chicago 11, Illinois.

MEDICAL SERVICE BUREAU

POSITION WANTED

General surgeon, male, age 43, Lithuanian, former tuberculosis patient, seeks position in sanatorium, no family, state license pending. Please address all inquiries to Box 278B, American College of Chest Physicians, 112 East Chestnut Street, Chicago 11, Illinois.

POSITIONS AVAILABLE

Staff physician wanted, Nebraska Hospital for Tuberculous. Experience desirable, but not essential. Salary dependent upon experience and qualifications. Should be eligible for Nebraska license. Give details concerning qualifications and references. Please address all inquiries to Box 269A, American College of Chest Physicians, 112 East Chestnut Street, Chicago 11, Illinois.

Thoracic Surgeon, 650-bed, fully accredited state tuberculosis hospital with complete, modern facilities, located in Midwest, near city of 80,000 population, has immediate opening for surgeon who is Diplomate American Board or who is Board eligible or Diplomate American Thoracic Board. After established full-time work at hospital, later be able to do part time work and establish private practice in nearby city which has excellent opportunities for thoracic surgeon. Salary $12,000 per annum. Please address all inquiries to Box 270A, American College of Chest Physicians, 112 East Chestnut Street, Chicago 11, Illinois.

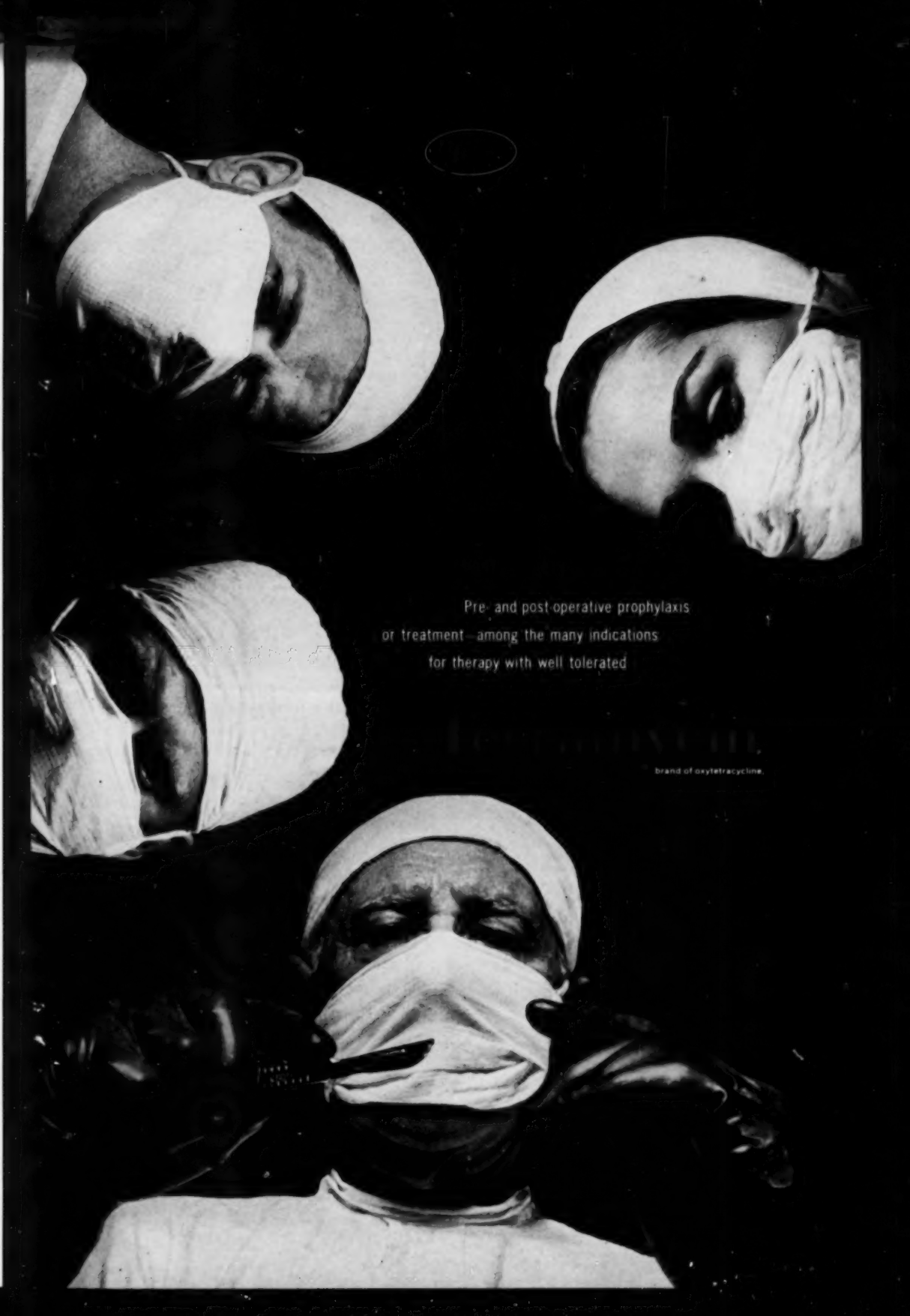
Internist wanted for 650-bed, fully accredited state tuberculosis hospital with complete, modern facilities, located in Midwest, near city of 80,000 population. Immediate opening. Must be eligible or Diplomate American Board. Salary $12,000 per annum. Please address all inquiries to Box 271A, American College of Chest Physicians, 112 East Chestnut Street, Chicago 11, Illinois.

Staff physicians, 650-bed, fully accredited state tuberculosis hospital, located in Midwest near city of 80,000 population has immediate opening for staff physicians who are graduates of American medical schools, who have finished approved internship or who have finished an approved internship and have had one or more years experience in tuberculosis or chest diseases: Physician I tuberculosis—starting salary $6,000 per annum to $9,000 in $500 steps annually. Physician II tuberculosis—starting salary $7,000 per annum to $10,000 in $500 steps annually. Please address all inquiries to Box 272A, American College of Chest Physicians, 112 East Chestnut Street, Chicago 11, Illinois.

Assistant Medical Director wanted for 225 bed sanatorium in Birmingham, Alabama. For details write Arthur J. Viehman, M.D., Superintendent, Jefferson Tuberculosis Sanatorium, Birmingham 9, Alabama.

Assistant or associate medical director wanted, preferably under 50. New modern 200 bed tuberculosis hospital. Salary up to $10,000 depending upon experience. Alabama license necessary. Unusually complete laboratory, x-ray facilities. Medical Director 38 years old, F.C.C.P., Assoc. A.C.P. board certified Internal Medicine. Please address all inquiries to Medical Director, District No. I, Tuberculosis Hospital, Decatur, Alabama.

The Veterans Administration Hospital, Downey, Illinois, 35 miles from Chicago, has several vacancies for physicians in the 297-bed tuberculosis unit of the hospital. Salaries determined by experience and qualifications: Department of Medicine and Surgery, $5,000 to $9,600 per annum. Applicants must be between ages of 21 and 54, hold degree of Doctor of Medicine from approved institution, and must have completed approved internship, as well as posess license to practice in a state or territory of the U. S., and must meet physical requirements. Write to the Manager, Veterans Administration Hospital, Downey, Illinois.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